

# computing today

JUNE 1980

ISSN 0142-7210

60p



**THE  
SPECTRUM  
OF HOME  
COMPUTING**

**REVIEWS ON:  
ZENITH Z89  
SINCLAIR ZX-80  
MICROTAN 65  
EXPLORER  
HP 85  
SYM 1**

### 8K ON BOARD MEMORY!

5K RAM 3K ROM or 4K RAM 4K ROM (link selectable) Kit supplied with 3K RAM, 3K ROM System expandable for up to 32K memory

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Cabinet size 19.0" x 15.7" x 3.3". Television not included in price.

### 2 MICROPROCESSORS

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### EFFICIENT OPERATION

Why waste valuable memory on sub routines for numeric processing? The number cruncher handles everything internally!

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resident in EPROM

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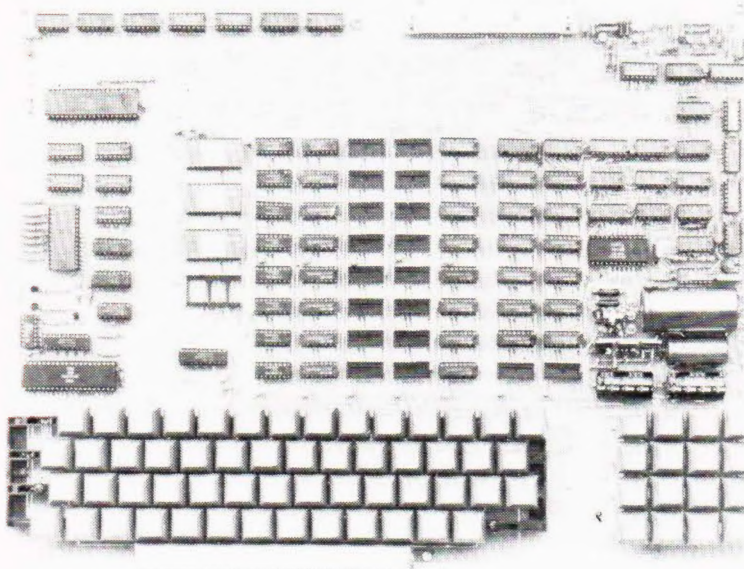
**£225 + VAT**

# POWERTRAN

## PSI Comp 80.Z80 Based powerful scientific computer Design as published in Wireless World

The kit for this outstandingly practical design by John Adams published in a series of articles in Wireless World really is complete!

Included in the PSI COMP 80 scientific computer kit is a professionally finished cabinet, fibre-glass double sided, plated-through-hole printed circuit board, 2 keyboards PCB mounted for ease of construction, IC sockets, high reliability metal oxide resistors, power supply using custom designed toroidal transformer, 2K Basic and 1K monitor in EPROMS and, of course, wire, nuts, bolts, etc.



### KIT ALSO AVAILABLE AS SEPARATE PACKS

For those customers who wish to spread their purchase or build a personalised system the kit is available as separate packs eg. PCB (16" x 12.5") £43.20. Pair of keyboards £34.80. Firmware in EPROMS £30.00. Toroidal transformer and power supply components £17.60. Cabinet (very rugged, made from steel, really beautifully finished) £26.50. P.S. Will greatly enhance any other single board computer including OHIO SUPERBOARD for which it can be readily modified. Other packs listed in our FREE CATALOGUE.

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Expansion up to 32K all inside the computer's own cabinet!

By carefully thought out engineering a mother board with buffers and its own power supply (powered by the computers transformer) enables up to 3 8K RAM or 8K ROM boards to be fitted neatly inside the computer cabinet. Connections to the mother board from the main board expansion socket is made via a ribbon cable.

<b>Mother Board</b>	Fibre glass double sided plated through hole P.C.B. 8.7" x 3.0" set of all components including all brackets, fixing parts and ribbon cable with socket to connect to expansion plug	<b>£39.90</b>
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(a division of POWERTRAN ELECTRONICS)

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# computing today

VOL.2 No.4  
JUNE 1980



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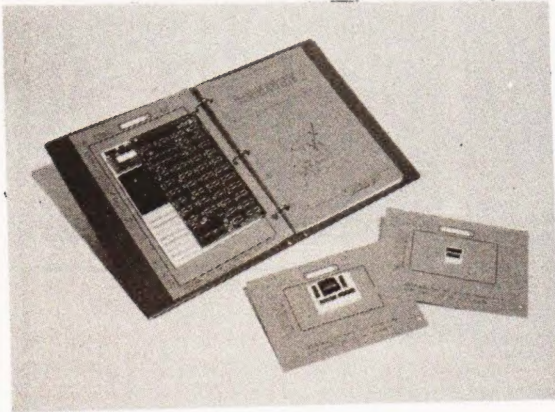
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# MICROTAN 65

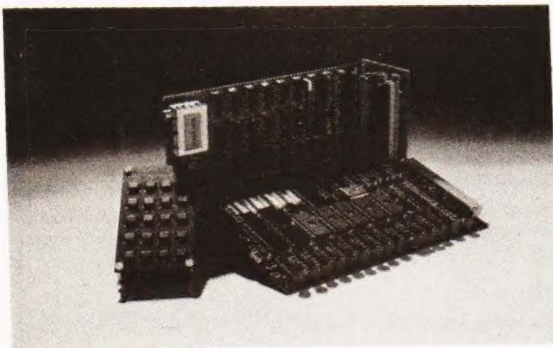
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## The Microcomputer that thinks it's a Mini



*The MICROTAN kit has won widespread acclaim for its super presentation.*

High quality, plated thru' hole printed circuit board, solder resist and component legends. Full set of I.C. sockets. 64 way D.I.N. edge connector. 6502 microprocessor. 1K monitor TANBUG. 1K RAM for user programme, stack and display memory. VDU alphanumeric display. Intelligent keyboard socket. A4 MICROTAN 65 system file binder. 136 page, bound, A4 size users hardware/software manual with constructional details and sample programmes. Logic and discrete components to fully expand MICROTAN 65.

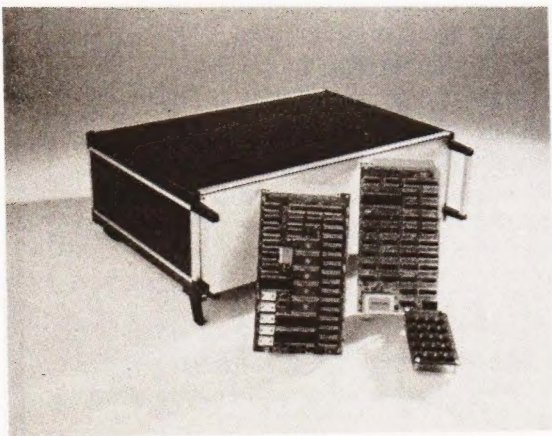


### TANEX

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Ready built the mini-mother board has two 64 way female connectors, a 4 way power supply connector and a reset switch on board. It is used to connect MICROTAN to TANEX, and will fit inside the mini system rack. £8.64 plus VAT.



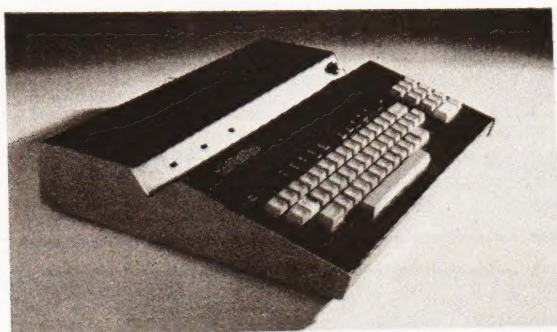
### Full System Rack

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Available in many formats e.g. Individual module front panels, full width hinged front panel, back panel with or without connectors, etc.

We have produced a mini-rack which accepts MICROTAN 65 and TANEX, it has an integral power supply, just plug it into the mains and away you go! Finished in Black/Tangerine/Brushed aluminium, it gives your mini-system the professional finish.  
£34.75 plus VAT



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The ASCII keyboard includes a numeric keypad and ribbon cable connector. Available only as fully built and tested.

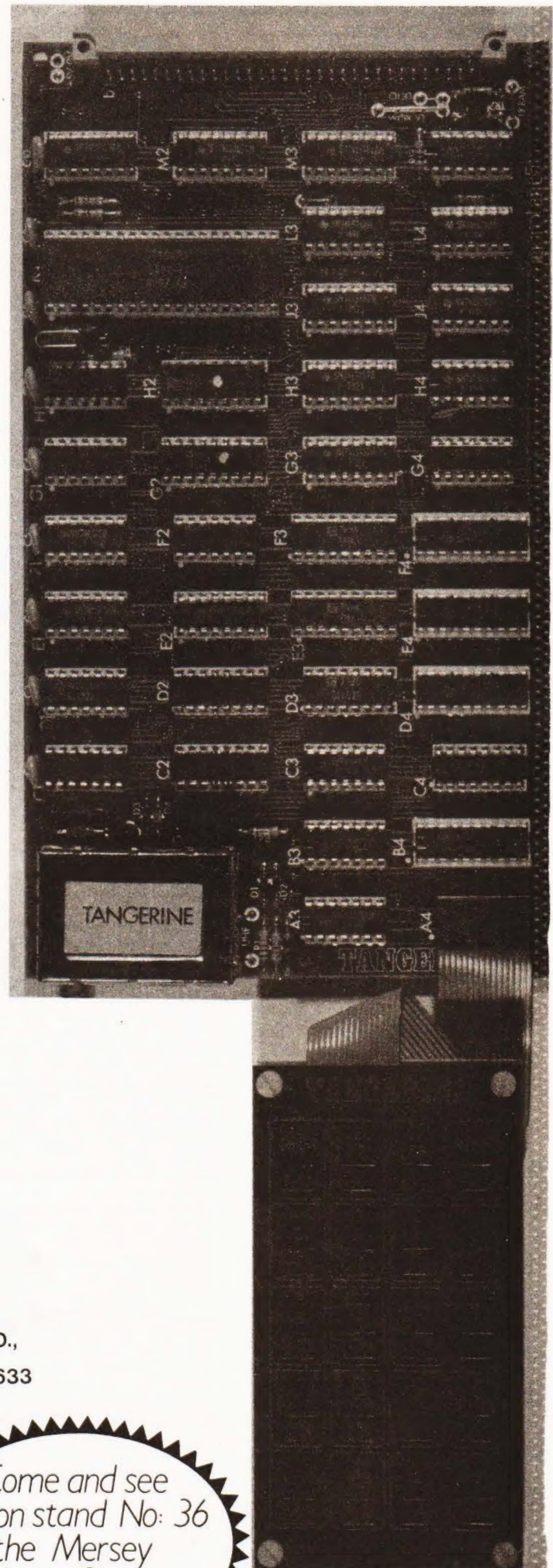
Cabinet available at £21.21 plus VAT.

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- The concept of TANBUG is excellent
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- The extremely reasonable cost has not been achieved by skimping on design
- A gem of a product
- An excellent introduction to 6502 based systems

- A 6502 based microcomputer.
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Micro Show



## HITCH HIKE A PET

Not only but also, Petsoft have managed to break into the publishing business with a volume entitled Hitch Hikers Guide To The PET. Originally prepared for the ACT staff by Chris Preston it covers the guts of the machine in great detail. The book is divided into three sections, Useful locations in the page zero memory map, Useful subroutines that you can call to save those acres of code and File handling which is self explanatory. No civilised programmer should be without one, rather like a Toolkit in read-only floppy format, and it is designed

for both the BASIC and machine code programmer. It costs £5 direct from your local shop or by mail order. Also announced this month, in connection with the new catalogue, is a talking calculator program that is coupled to the PET sound-box. The cost of the software is a mere £10 and the necessary hardware is a further £27 making it a cheap aid for a handicapped programmer or just as another means of checking yourself when inputting vast amounts of data. Petsoft hang out at PO Box 9, Newbury, Berkshire RG13 1PB or at Radcliffe House, 66/68 Hagley

Road, Edgbaston, Birmingham B16 8PF. A T-shirt has just fluttered into my hands from the Spoof Press Release organisation at the above address. In stunning white with a red and blue logo it'll set you back £3.45 in small, medium or large sizes, demand has been caused by the high prices offered by the general public to honest employees of ACT to strip to the waist at computer fairs. Perhaps we'll see micros in M&S next!

## STIFFEN A FLOPPY

If you send floppy discs through the post you may have to resort to pieces of cardboard, old shirt fronts or anything else that'll stop it being bent whilst under the care of the Post Office. Your worries are over now with the launch of a mailing pack by Swan Packaging. Available in two sizes to cope with both 5¼ and 8" types it can hold up to six discs for postage. No price is available at the time of writing but details can be obtained from Swan at 89/99 Cambridge Street, Coventry.

## DEATH OF A MICRO

One of our kind readers has sent in a compliments slip from Science of Cambridge that makes sad reading. It simply says "Sorry, Mk 14 discontinued enclosed are details of ZX 80". Never fear though, CT is still going to keep its doors open for software written for the machine and, like the many owners, mourns the passing of a very popular system. Progress is, after all, progress.

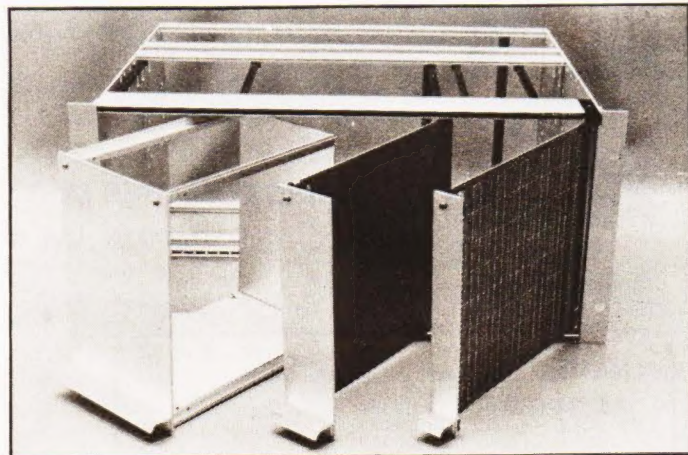
## MOVING HOUSE

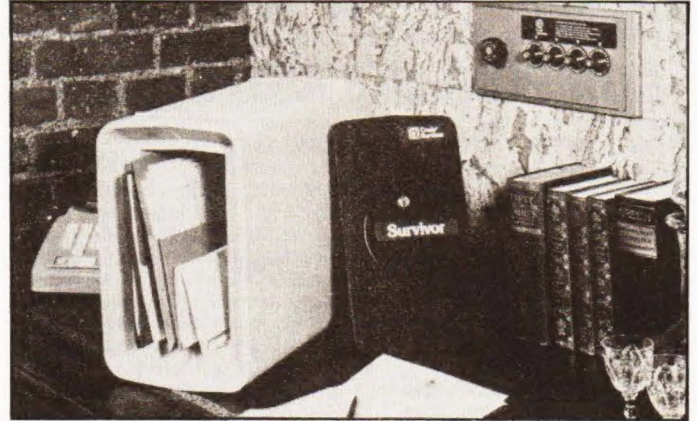
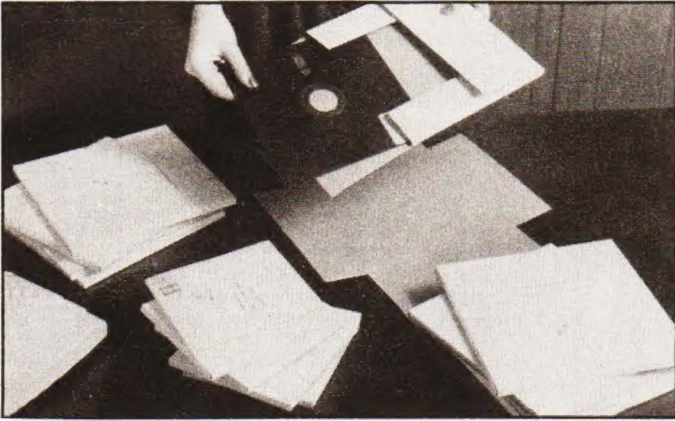
Two of the companies that feature from time to time within these pages are moving to new and better premises. U Microcomputers are now located at Unit 12A Winstanley Industrial Estate, Long Lane, Warrington WA2 8PR and doubtless celebrated their move with the local Wodka! Their new phone number is Warrington 54117. The second company to shunt off around the country are Hazeltine the VDU people. Their new abode is 292 Worton Road, Isleworth, Middlesex TW7 6EL and their phone is 01-568 1851, they probably celebrated with Youngs!

## BOXING CLEVER

Owners of the Nascom range of computers are often heard to complain about the lack of casings and boxes that are available for them. Well, CT's spy in the workshops of a well known casing company has discovered a few very interesting facts. Lovers of the Vero catalogue will know that they make a vast and diverse range of racks and cases, it's often a problem to find the right one. Now as a standard item there is a rack system known as 3D-N which,

as our photos show, appears to be exactly the right size for a Nascom and its attendant boards and power supply. The price of the kit is £24.48 and this includes the connector rails, guides and nuts and bolts. Also available in the range are a number of extras such as front panels, modules, veroboards in both glass and SRBP, a case which actually fits and several other goodies. For full details of the kit contact Vero at the Industrial Estate, Chandlers Ford, Hampshire SO5 3ZR quoting the reference 3D-N and they will give you the information. Remember that we are watching!





## BURNPROOF SOFTWARE

Do your floppies wilt when they get too hot? Are you worried about giving your tapes a sun-tan? If the answer is more serious and you are concerned with protecting your software against fire then a new deposit

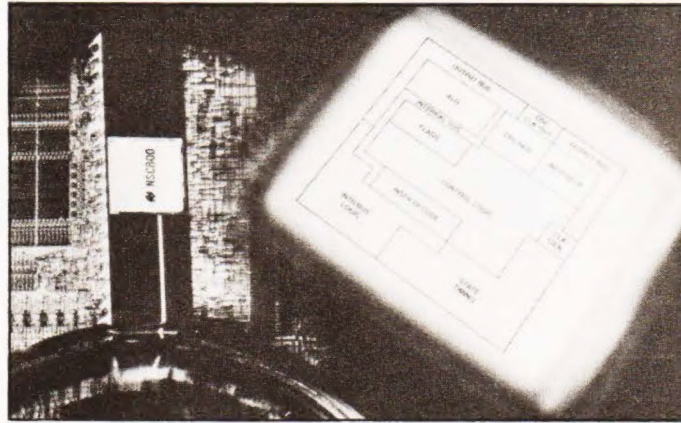
box may be of interest. Called the Crado Survivor it is a dainty 330 by 203 by 442 mm in size but gives fire protection equal to two feet of solid concrete. The inside space is ample for floppy discs, cassettes and even

A4 documents and the whole thing can be double locked as well for security. The box weighs in at a mere 35 lbs so it's not too difficult to lug around and you can even take it abroad with you, it is 10 lbs

less than the baggage allowance. Cost of this piece of insurance is £59.80 and further details are available from the manufacturers, Crado Devices, 3 Bluebell Wood, Billericay, Essex CM12 0ES.

## DOUBLE TROUBLE?

National Semi, those fearless chip people, have decided that the world of microprocessors needs a shot in the arm. To stimulate this they have launched a complete new family of eight-bit micros fabricated in, wait for it, double poly CMOS (gulp). Designated the NSC800 it includes all the best bits of existing micros along with many enhancements that make it very easy to use. Packed into the usual 40 pin case it offers such varied delights as a 1 micro-second instruction cycle at 5% of the normal NMOS power, address and data bus structure of the 8085 and the Z80 instruction set. Included as support devices are the 810 RAM I/O timer and the 830 ROM I/O, both being made in the P<sup>2</sup>CMOS fashion. Both the new devices are designed to hang on the bus directly, saving time and effort in the design department. They reckon that with the three



chips you get 2K ROM, 128 bytes RAM, two 16 bit timer counters, five interrupts and 32 I/O lines. The press release says that you get two 16 byte timers but I think that is a little unlikely! Power dissipation is a miniscule 100 milliwatts so it is a likely candidate for battery back-up. The release goes on to

say that the power requirement is "a single, loosely regulated, power supply with a range from 3 to 12 volts." which might sound as though the device isn't too fussy. If you are intrigued by this then contact National Semiconductor at 301 Harpur Centre, Horne Lane, Bedford or ring Bedford 47147.

## CLUBBED TOGETHER

Two new clubs and a plea for help are this month's meagre offering. The Comp 80 computer has attracted a user group whose aims are to support and assist others with the same machine. The club is yet newly born and anyone who is interested should contact the newsletter editor, P.L.Probetts at 50 Cromwell Road, Wimbledon, London SW19 8LZ. The subscription will be £5 per annum. The second arrival is a national T158/59 user group that is to be run on an unusual basis. If you send in a program then you will get one back, free of charge — otherwise it'll cost you 50p. This is even reflected in the membership cost, £5 normally or £3 for anyone who sends in a fully documented program, CT has its eye on you! Information is available on building cassette interfaces and adding to the memory and hopefully a micro-calculator interface will be produced. Details from R.M.Murphy, Dept. Electrical Engineering, University College, Singleton Park, Swansea. And finally a plea for help from several people. There used to be an Independent Nascom Users Club run by J.Twell in Lancaster but we, and many of you, can't get any replies to telephone or postal enquiries. Do they still exist, did they ever exist (someone sent in a club registration form) where are they now? If you can help please drop a line to CT at our usual address and make someone happy.

## BOLT ON FRONT END

Not something that you fit to your car but a replacement keyboard for the original version PETs. Called PERK it is produced by Electronic Brokers of 49/53 Pancras Road, London NW1 2QB and provides all the usual key functions plus a proper SHIFT and Alpha Lock control for extra convenience. The cost of the unit is £145 and no modifications are needed to the PET in order to connect it, it is even self powered to avoid loading the on-board regulators.



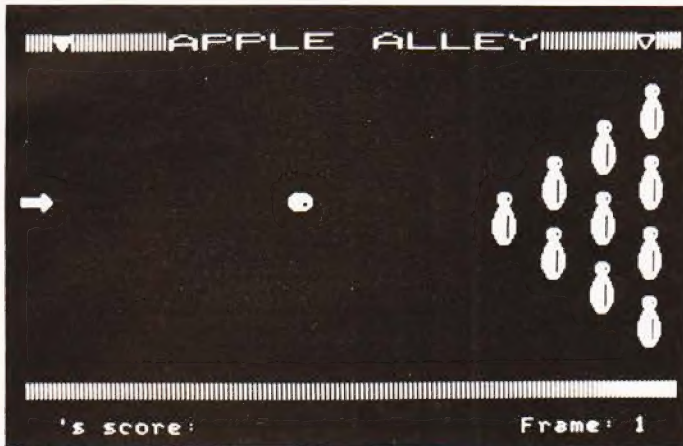




## SOFTWARE BREEDS

Petsoft, those people who hog the news each month, have produced an offshoot in the guise of Appeware. The initial launch is a catalogue of 75 programs that are established as best sellers, all are of US origin at the moment but it is envisaged that UK contributions will emerge shortly. Typical programs now available are Visicalc at £125, Apple Invaders at £8 and a speech synthesis program at £14.95. All the software is currently on disc only. At last a central supply of software is

available for the Apple which should make it lift its head in the market, it has suffered before from a lack of goodies to feed it on. Julian Allason, that well known Sunday Times personality, is well set on carving out another portion of the personal computer market, it is conceivable that Appeware will prove to be another Petsoft, good luck to it. Details from ACT Appeware, Radcliffe House, 66/68, Hagley Road, Edgbaston, Birmingham B16 8PF.

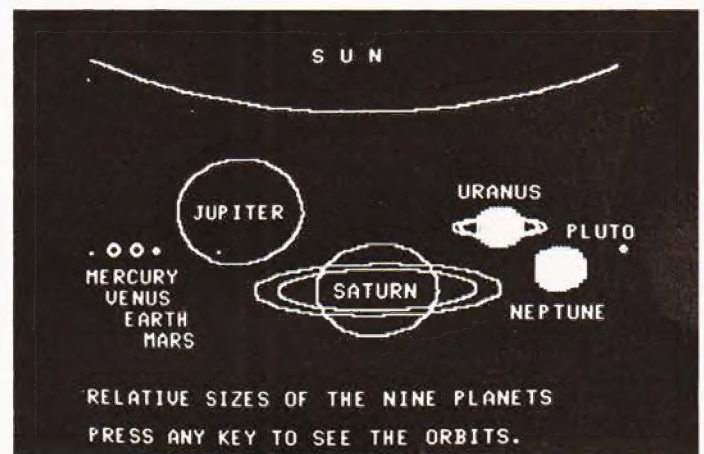


## WORDS ON WORDS

The first in a new series of programs for T.R.S.80 level II users, from I.C. Electronics is a Word Processing Program. With a suitable printer connected, it allows the keyboard to be used as a typewriter with full shift facilities for capital and lower case. Individual lines can be edited before or after printing and once the letter is entered it can be printed as many times as required or stored on tape for future use all under program control. Two page letters can be produced on standard 11 inch paper but the program is fully documented with details of the program changes required for different paper sizes. 16K of RAM is needed and the price of the program is £15.00 including V.A.T. and postage. This price also includes the cost of formatting the purchasers own address heading into the program so it is ready for immediate use. Details from I.C. Electronics, Biddenden, Ashford, Kent. TN27 8JG. Telephone 0580-291816.

## MICRO SPONSORSHIP

News has just reached us through the Department of Industry that the government are to sponsor a microprocessor competition specifically for schools. The DOI, in conjunction with the Microprocessor Applications Group and the Department of Education and Science, are to hold a competition for secondary schools with, currently, 100 British microcomputers as prizes. The competition will be of essay form and your headmaster should, by now, have received details of entry. To further the application of micros in education talks are currently being held with local organisations, such as banks and industry, with a view to raising the amount of systems available as prizes. We understand that more details will be announced in the very near future and we will keep a space free for these as they come in.



## NASCOM TOP 50

The INMC software library has now reached 50 titles and the prices are from 10p to £1.50 for the software listing. Full details of the list are now accessible to members of the public in the Issue 6 Newsletter at a price of 90p from your local stockist or £1.05 from the INMEC. Membership of the user group, which includes the newsletter, is only £5 per annum plus an enrolment fee of £1. Among the goodies contained within its pages is a detailed description of the new NASPEN text editor/formatter. This useful hunk of firmware comes in two varieties, VT for T4 and VS for Nassys at a price of £30 plus VAT - for which you get two EPROMs and the docu-

mentation. Details from your local shop or direct from Nascom at 92 Broad Street, Chesham, Bucks.

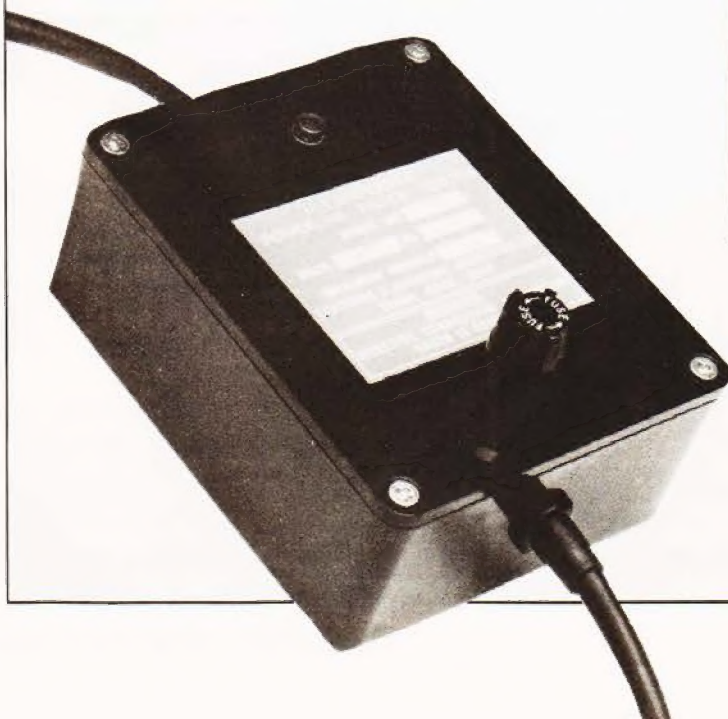
## PICO-BASIC

A number of small and irritating errors appear to have worked their way into the Pico BASIC article (April). Fortunately not all of them are by any means fatal, and not all of them were ours (honest!) The necessary corrections are: page 56 column 1 address 0E1A should be 0F1A, page 58 column 2 at address 0293 comment should read "more than A shifts", page 60 column 1 at address 05EE comment should read ". =n?", page 60 column 1 at address 05F0 comment should read ". .if L(K).

## ELIMINATE IT

Back in our January issue we mentioned a device for removing the harmful effects of lightning before it struck your poor defenceless micro. The company who produced it have been overcome by the idea and have now produced a slightly smaller unit called the Kleanpower LEA MB3 which is suitable for use in the home computer market. The facts and figures are impres-

sive, I didn't understand them, but it certainly seems to be a more effective spike-stopper than a conventional filter. Price is £35 which seems a small cost against the loss of RAM contents and other general disruption that central heating, deep freezers, fridges and other nasties can cause. For details contact Lightning Elimination Associates at Vine Cottage, Moreton, Thame, Oxfordshire.



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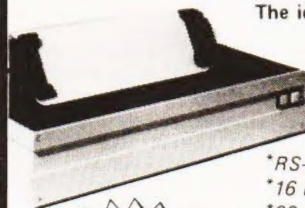
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# COMPETITION RESULTS

## CONGRATULATIONS

This is the moment for which you have been waiting, our Birthday Competition results! A fantastic response meant that our overworked Editorial department spent hours sorting correct answers and finally, after much persuasion, our lovely Editorial Assistant, Tina Boylan, stuck her mit into the box. The correct answer to the crossword is shown below, well done to all of you who got it right, the correct code number was 317, and extra congratulations to the winners who were :

First : Mr. A. Withers of 20 Langford Road, Portsmouth (16K PET plus Petsoft goodies).

Second : Michael Droney of Kelvedon, Woodbury Grove, Lovedean, Hants (Nascom 2).

Third : John Hall of 23 Park Terrace, Kirkby Stephen, Cumbria (Nanocomputer).

Fourth : Jim Mayoh of 11 Steeton Avenue, Haworth Park, Hull (Acorn).

Fifth : Philip Rutherford of 24 Broad Acres, Hatfield Garden Village, Hatfield, Herts who collects the Star Devices keyboard.



1	S	I	N	G	L	E	S	T	E	P	S	5			
	I			O		R		R				O			
	G			6	T	R	A	C	E			R			
2	N	8	A	N	O		S		9	E	X	10	I	T	
	B						E						D		
	11	C	O	B	O	L		12	A	P	P	L	E		
		R					13	M					E		
	14	A	T	O	D		15	O		16	E	N	D	17	S
		J				18	I	N	D	E	X				E
		O				S		E		O					E
	19	B	E	N	C	H	M	A	R	K	E	D			

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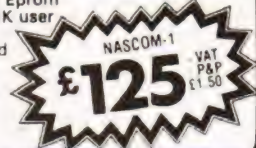
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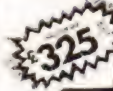
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## Have you the strength of character to battle it out in an industrial dispute? Test your strategy on this remarkable simulation.

**S**hop Steward is a BASIC game simulating Trades Union activity at a small firm during an economic crisis. Through industrial action of various types the player attempts to maximise support, wages and membership, hopefully without antagonising the management and provoking lockouts, or similar problems, which could threaten the continued existence of the firm in a variety of ways. The player must also liaise with the management (the computer) over redundancy policy and the controversial issue of new technology.

### The Program

A flowchart of the main section of the program is shown in Fig.1, for simplicity it excludes the branches for various types of game-termination (voluntary or otherwise!), but it should show fairly clearly the sequence of events followed. In the listing itself, lines 100-190 are for initialisation, 200-510 are the main program body, including various branches to handle special circumstances. These branches all meet up again on line 520, and after a few checks and the calculation of the new price level the whole program loops unconditionally back to line 200 for the next printout of the current situation. Each 100 lines from 600 to 900 consists of a section for the various 'special circumstances' mentioned above, and the routines from 1000 to 1300 handle the various ways in which the game can end. Variables are used as follows:

I = Industrial action.	D = Last I.A. reply.
P = Production.	L = Profit/Loss.
O = Pay Offer.	E = Firm Efficiency.
B = Bank Balance.	S = Support for Union.
C = Prices.	W = Wages.
F = No. of workers.	R = Redundancies.
M = Management confidence.	A\$ = General string reply.
G = General purpose (Delays, Score, Blacklegs, Redun. Reqd., etc.)	
T = No. of turns elapsed.	

### Adaptation To Other BASICs

The program is written in a form compatible with most implementations of BASIC - Integer or Floating-point - and should fit comfortably into 8K of memory on most machines. The listing is in the APPLE Integer language; modifications for other machines may include:

- (1) Replacement of CALL -936 in lines 100, 205, 1330, with the equivalent screen-clear and home-cursor instruction.
- (2) Changing 'RND (10)' etc. to equivalent routines that return a random integer between 0 and the number subscripted less one. (e.g. 0, 1, 2, ... 9 for the example.)
- (3) Inclusion of INT statements to tidy up results: to give whole numbers of blacklegs, for example! A check for integer input could be added to line 305, i.e. .5 OR A#INT (A) : . . . etc.



(4) If your BASIC does not support logical expressions, as in  $A = A * (A > 5)$ , where the expression in parentheses evaluates as 1 if true and 0 if false, these will have to be written out as a series of IF...THEN statements - the example corresponds simply to IF  $A \leq 5$  THEN  $A=0$ . If your BASIC evaluates true as -1, you will have to change a few signs in the relevant lines.

### Playing The Game

After a very few trials it will be found that while it is not difficult to remain in power as the shop steward - provided that you are not too aggressive! - it is quite difficult to keep all of your objectives at optimum level. The crucial quantity, which tends to dictate your policy to some extent whatever you intend to do, is the firm's efficiency variable E. This is set to a random value from 10 to 19 by the program as written, but by slightly modifying the program to allow this figure to be set, or to fall in a different range, interesting if somewhat trying results can be obtained at times! The score equation in line 1310 may also be modified to reflect different circumstances - as it stands it simply aims to incorporate all the ingredients that would tend to indicate successful play, but it does tend to set a premium on 'survival'!

The turns were originally fairly arbitrary amounts of time: depending on the industry, about two months would seem realistic, bearing in mind that a strike at the decision-point in a turn does not necessarily go on for the whole period (although its effects would probably continue to be felt for some time). The escalating prices as the game goes on, contribute to the crisis-situation that adds to the games interest. Although it is a caricature, most of the people that have played the game seem to detect the occasional parallel with the real world. .?!

In conclusion, CT presents the definitive game for the underworked picket. 'Shop Steward' gives you the chance to rule the country from the comfort of your own home/shed/barricade.

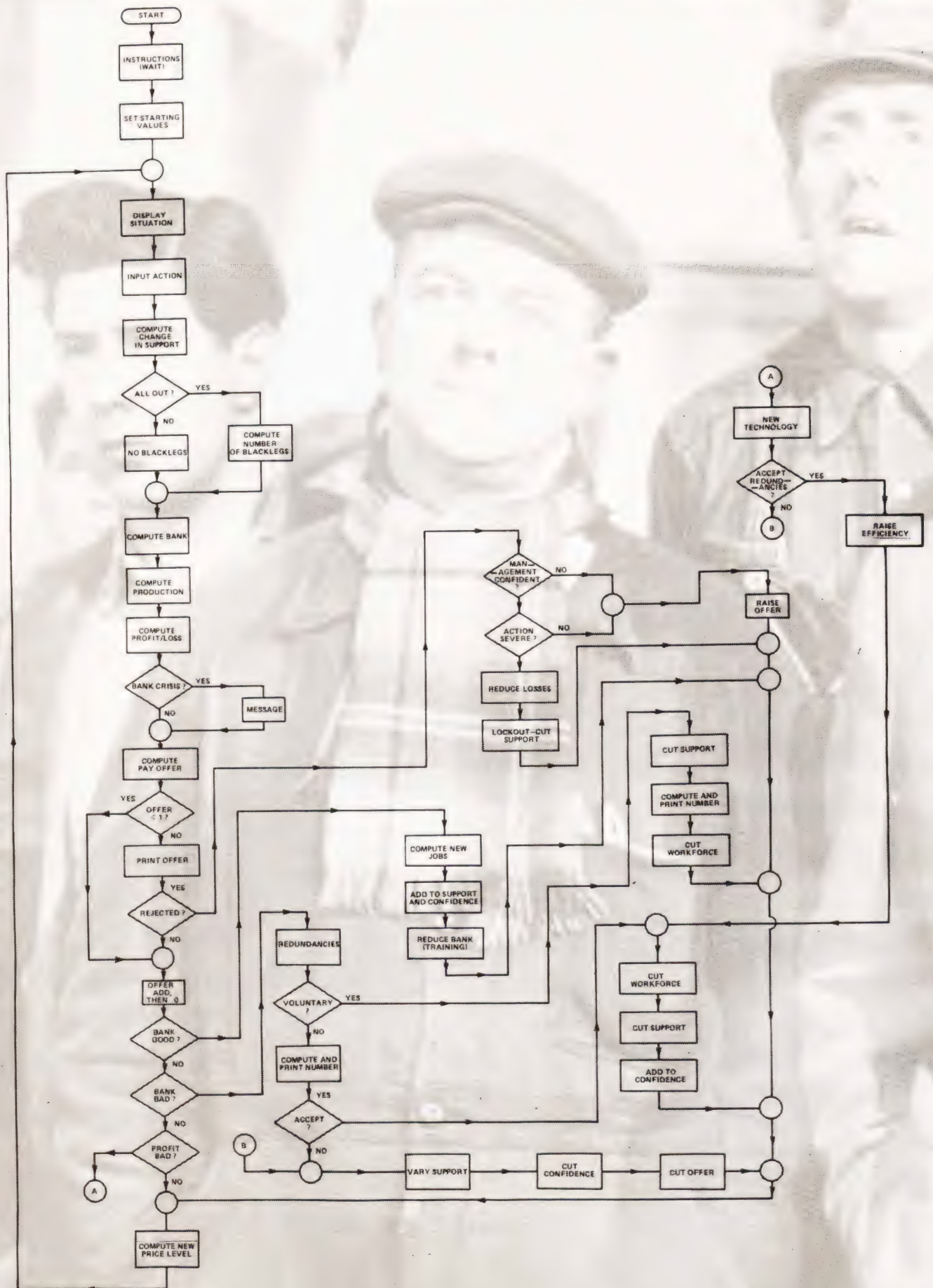


Fig. 1. Flowchart for Shop Steward.

# SHOP STEWARD

```

100 CALL -936: REM ***** CLEAR VDU
110 PRINT "##### SHOP STEWARD 2.
#####": PRINT
120 PRINT "PROGRAM BY S.N.GOODWIN.": PRINT
130 PRINT "YOU ARE SHOP STEWARD AT A SMALL
FIRM PRODUCING CONSUMER DURABLES":
140 PRINT "YOU AIM TO MAXIMISE SUPPORT,
NUMBER OF WORKERS, AND PAY LEVEL."
150 PRINT "WARNING! THE ECONOMY IS ON THE
VERGE OF COLLAPSE . . .": PRINT
160 INPUT AS: REM ***** WAIT
170 REM ***** INITIALISE
180 P=100:E=RND (10)+10:B=E:S=60
190 C=100:W=100:F=100:M=100:L=10
200 FOR G=0 TO 1000:NEXT G
205 CALL -936: REM ***** CLEAR VDU
210 T=T+1:PRINT "CURRENT SITUATION.":T:PRINT
220 PRINT "PRODUCTION ";P;" PROFIT/LOSS";L
230 PRINT "BANK BALANCE" ;B:PRINT
240 PRINT "PRICES ";C;" WAGES" ;W
250 PRINT "SUPPORT FOR UNION ";S;"%":PRINT
"NUMBER OF WORKERS" ;F:PRINT
260 PRINT "ENTER INDUSTRIAL ACTION - "
270 PRINT "0=NONE, 1=PRESSURE ON
MANAGEMENT,"
280 PRINT "2=WORK-TO-RULE, 3=WILDCAT
STRIKES,"
290 PRINT "4=ALL OUT, COMRADES, 5=END."
295 LET Q=A
300 D=A: INPUT A: IF A=5 THEN 1300
305 IF A < 0 OR A > 5 THEN 260
310 S=S+A+(W-C)*200/W
320 IF L < -20 OR B < -60 OR W > C THEN S=S-A*2
330 IF S > 100 THEN S=99
340 IF S < 20 THEN 1000
350 IF A=4 THEN 360
355 G=0: GOTO 380
360 G=40 -S/2: IF G < 0 THEN G=0
370 PRINT "THERE ARE ";G;" BLACKLEGS."
380 R=0:B=B+L/2:P=4*F/5--(3 ^ A)*F/100+E+G*2
390 L=P-F+60-50*W/C+ RND (3)-3*D
400 IF B < -150 THEN 1100
410 IF B < -50 THEN PRINT "THE FIRM IS IN
FINANCIAL TROUBLE."
420 IF B < -100 THEN PRINT "THEY ARE CLOSE TO
BANKRUPCY!"
430 O=O+A-(B > -90)*(W-C)+((ABS(M/20)+S/20)*
C)/200-5+(A > 2)*(A: IF O < 1 OR A < Q THEN 480
440 PRINT "MANAGEMENT OFFER A ";O;"% WAGE
RISE."
450 INPUT "TYPE 'A' TO ACCEPT.":AS
460 IF AS#"A" THEN 600
470 W=W+O
480 LET O=0
490 IF B > RND (50)+50 AND L > 1 THEN 700
500 IF B < -(RND (30)+5) THEN 800
510 IF L < -(RND (40)+10) THEN 900
520 REM ***** RETURN TO LOOP
530 C=C+((L > 1)*(L/6))+RND (3)+((F > 100)*((F-
100)/6))+((W > C)*(W-C)/3)
540 IF W < 20 THEN 1200
550 IF S > 100 THEN S=99
560 REM
570 REM
580 GOTO 200
590 REM ***** MANAGEMENT RESPONSE
600 IF A > 2 AND M > 20+RND(80) THEN 620
610 O=O+(50-M)/25: GOTO 520
620 PRINT "MANAGEMENT LOCKOUT : NO WORK
POSSIBLE!":PRINT
630 B=B-L-F/4:S=S-(M/10)*(M < 0)
640 GOTO 520
690 REM ***** EXPAND WORKFORCE
700 R=(-B+W-100)/2-1: IF R > -1 THEN 520
705 S=S-R*3/2
710 PRINT "THE MANAGEMENT HIRE ";-R;" NEW
WORKERS."
720 M=M+M/8:F=F-R:B=B+R*3/2: GOTO 520
790 REM ***** REDUNDANCIES
800 G=RND (4)+(L/2*(L < 0))+1
805 IF G < 2 THEN 520
810 PRINT : PRINT "REDUNDANCIES - ": PRINT
815 LET R=G
820 PRINT "TYPE 'A' TO ACCEPT VOLUNTARY
REDUNDANCY PLANS.": INPUT AS
830 IF AS#"A" THEN 860
840 PRINT :S=S-G:R=(100-S)/10+G/2:M=M+10-ABS
(R-G)
850 PRINT "THERE ARE ";R;" VOLUNTEERS.":F=
F-R: GOTO 520
860 PRINT : PRINT R;"WORKERS MUST GO."
865 INPUT "TYPE 'A' TO ACCEPT",AS: IF AS = "A"
THEN 880
870 M=M-M/8:O=-O- RND (R+1):S=S+R-2: GOTO
520
880 F=F-R:M=M+M/10:S=S-R*3/2: GOTO 520
890 REM ***** NEW TECHNOLOGY
900 PRINT :R=ABS (B/10)+1
910 PRINT "NEW TECHNOLOGY PLANS REQUIRE
";R;" REDUNDANCIES."
920 INPUT "TYPE 'A' TO ACCEPT.":AS: IF AS#"A"
THEN 940
930 GOTO 870
940 E=E+R: GOTO 880
990 REM ***** LOW SUPPORT KO
1000 PRINT : PRINT "THE UNION REMOVE YOU
FROM OFFICE DUE TO COMPLAINTS FROM THE
WORKERS."
1010 G=-100: GOTO 1300
1090 REM ***** BANKRUPCY KO
1100 PRINT : PRINT "THE FIRM HAVE BEEN FORCED
INTO LIQUIDATION."
1110 G=-80: GOTO 1300
1190 REM ***** WORKFORCE SHRUNK KO
1200 PRINT : PRINT "THE SIZE OF THE WORKFORCE
MAKES THE FIRM NO LONGER VIABLE."
1210 G=-60: GOTO 1300
1290 REM ***** THAT'S ALL FOLKS
1300 PRINT : TAB (20): PRINT "GAME OVER."
1305 IF G > -50 THEN G=0
1310 G=S+F+(C-W)*400/W+B/3+M/6+G-150+T*4
1320 PRINT : PRINT "YOU SCORED";G
1330 FOR G=0 TO 2000: NEXT G
1340 CALL -936: REM ***** CLEAR VDU
1350 END

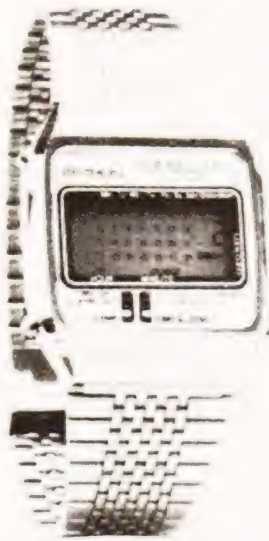
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## System monitors are vital to the programmer, and they can save you a lot of work too.

In this third part of the series we will take a cursory look at the features offered by the majority of systems in their integral 'system monitors' and in particular those that can be incorporated in user programs. The methods used to display information on the Visual Display Unit (VDU) or TV screen will also be discussed and then the way will be clear to begin formulating a real program.

### System Monitors

All microprocessor systems that are interactive and used for the development and running of user programs incorporate a system monitor. This is a special program written by the system designers to enable programs to be entered, displayed, amended and run. This program is typically 1 or 2K Bytes long and is packaged in a Read Only Memory, either at the bottom or at the top of the RAM area. Whilst it is not our intention to enter into detail on any one specific system until the final part, all well designed monitor programs are formed around subroutines that can be utilised in user programs and some of these will be described below. It cannot be stressed too highly that programmers must at all times have at their fingertips the building blocks available on their processors.

### Typical Routines

#### Input :

There are usually two main input subroutines that can be accessed. One will obtain an input from a peripheral device such as a paper tape reader or cassette tape recorder, the other is used to obtain data being read in by way of the keyboard. It is normal for this latter routine to be so constructed that it can be used in two ways:— It can either sit in a loop, continually scanning the keyboard awaiting the next instruction from the operator or it can be programmed to continue carrying out its dedicated task until the operator interrupts with an input from the keyboard. The best example of this is a stop-watch program; the time will continually be incremented and the keyboard scanned looking for an input but it will only be when a key is pressed that the timing operation will be arrested.

As the keyboard input routine is used so frequently in user programs it is quite normal for it to be accessed from a system restart.

#### Output :

Here again there are usually two main routines — that to output data to a port for transfer to paper or magnetic tape, and the more commonly used transfer of data for display on a VDU or TV screen. This routine is also commonly available on a system restart but it must be remembered that the data to be output usually has to reside in the Accumulator or A register and be in ASCII code corresponding to the character to be displayed. (The ASCII code will be discussed in detail later on.) In order to achieve those functions mentioned above the output routines often have smaller subroutines within them that can be useful, routines that, for example, will convert a hexadecimal number into ASCII, or take an 8-bit hexadecimal number and display it as two 4-bit numbers ASCII weighted for display.

#### Text Strings :

These are not to be confused with strings used in high level languages. One extension of the output routine is to display a succession of characters such as a title or a message. When this routine is entered a program loop is initiated which will display on the screen the subsequent data or message until a predetermined delimiter is reached. This limiter is normally 00Hex or FFHex. Here again it is important to remember that text has to be changed to its ASCII equivalent.

#### Delay :

A delay subroutine is another useful tool. It is primarily provided to overcome contact bounce from the switches used in the keyboard, and to adjust the speed that data is output from the system when peripheral equipment is used, eg Teletypes or printers. When incorporated in a user program it is usual to be able to adjust the length of the time delay in proportion to the maximum provided delay. If, for example, a value of FFHex in the Accumulator gives a delay of 14 mS, then 80Hex will give approximately 7 mS and 40Hex will give approx 3.5 mS. If values greater than the 14 mS are required then more than one delay subroutine can be used, or alternatively it can be incorporated in a countdown loop. In this way if the delay routine were called FFHex times in succession then the total delay will amount to approximately 3.5 seconds.

In addition to the above the more advanced monitors like that devised for the Nascom 2 have made all the monitor commands available to the user enabling very efficient programming.

### ASCII Code

Known to its friends as ASCII its real title is American National Standard Code for Information Interchange. Some beginners seem to get themselves in an awful muddle with ASCII, particularly when copying published programs that list messages in TEXT and expect the reader to make the conversion. In Table 1 a list is given showing the allocations of control codes from 00–20 Hex and the usable characters from 21–7F Hex.

	MSD	0	1	2	3	4	5	6	7
LSD	000	001	010	011	100	101	110	111	
0	0000	NUL	DLE	SP	0	@	P	\	p
1	0001	OSH	DC1	!	1	A	Q	a	q
2	0010	STX	DC2	"	2	B	R	b	r
3	0011	ETX	DC3	#	3	C	S	c	s
4	0100	EDT	DC4	\$	4	D	T	d	t
5	0101	ENG	NAK	%	5	E	U	e	u
6	0110	ACK	SYN	&	6	F	V	f	v
7	0111	BEL	ETB	'	7	G	W	g	w
8	1000	BS	CAN	(	8	H	X	h	x
9	1001	HT	EM	)	9	I	Y	i	y
A	1010	LF	SUB	.	:	J	Z	j	z
B	1011	VT	ESC	+	;	K	[	k	;
C	1100	FF	FS	,	<	L	\	l	;
D	1101	CR	GS	-	=	M	]	m	}
E	1110	SO	RS	.	>	N	!	n	~
F	1111	SI	VS	/	?	o	←	o	DEL

Table 1. The ASCII code chart.

Each letter, number or control has a dedicated ASCII code in Hexadecimal form and it is this equivalent that *must* be entered into the machine code program if the correct display is to output.

eg '7F ASCII codes' would be entered as  
 37 46 20 41 53 43 49 49 20 63 6F 64 65 73  
 7F ASCII codes

(note that a 'space' has to be indicated by its ASCII code ie 20 Hex.)

There are some important observations to be made from studying this list in that all numbers are in the 30 Hex range, and all lower case letters are exactly 20 Hex up on their upper case equivalent. Thus the letter 'E' is 45 Hex and 'e' is 65 Hex. These concepts considerably ease conversions; in the case of numbers, ASCII to real values are obtained by subtracting 30 Hex and changing the 'case' of letters is achieved by simply adding 20 Hex.

### Displays

There are two main types of display formats that are currently in use today; the serial display which always prints on the top or bottom line and then scrolls, and the memory mapped display that is used on most of the home computer systems. As the serial display is so straightforward only detailed explanation of the memory mapped display will be given.

When memory mapped displays are used, a small section of the user RAM area is dedicated for use as the Video RAM area. To the programmer it appears identical to all the other RAM addresses and can be written to and read from in the normal way. The difference to the system is that the RAM addresses are allocated as a matrix for display on the screen. The size of this matrix varies from system to system, dependent on the number of characters that are to be displayed across the screen and the number of lines that are to be used. Typical sizes are 48 or 60 characters across with 16, 24 or 32 lines. For simplicity Fig.1 shows an abridged memory map of 16 characters across and only 5 lines. To display the letter A on the screen in the position shown the ASCII code for A (ie 41 Hex) would have to be entered into the memory address that corresponds to that position.

In our example the memory address can be determined from the matrix co-ordinates, 1020 + 4 ie address 1024. The instruction would therefore be in the form: 'put 41 Hex into the memory location 1024'

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
1010																
1020					A											
1030																
1040																
1050																

Fig.1. An abridged memory mapped display.

In many machines that have memory mapping a device called a cursor is provided by the system monitor to indicate the position that will be next used on the display. This cursor comes in many forms, sometimes as an underline character, sometimes a full stop that flashes or even as a flashing white box. It is also usual to be able to move the position of the cursor around the screen to locate a particular character that is to be changed or deleted. Extensive use of this facility is made in text editor and word processor systems.

### Formulating A Program

With the descriptions of the system and CPU features behind

us the way is clear to begin formulating a program. The early stages of programming are identical for all systems and languages, even the various high level ones.

It would be stating the obvious to say that first it is essential to decide on the program that is wanted, but many programmers adopt a policy of 'let's work it out as we go along'.

The main stages in the development of a program are listed below :-

1. Research
2. Production of a theoretical program (eg flowcharting and algorithm)
3. Machine coding
4. Testing and debugging
5. Tidying the proven program
6. Documentation

### Gregorian Calendar Program

In order to demonstrate the processes listed above a Gregorian Calendar program will be produced to display, on request, any month of any year between two specified limits. Some programs may be self evident and not require any technical research but in this case it was considered wise to check the rules and formulate a list of requirements.

Unless you are fortunate to have an encyclopaedia that tells you what you want to know rather than what you need to know, a trip to the library is often called for. In none other than the Encyclopaedia Britannica we read that Britain changed from the Julian calendar to the continental Gregorian calendar in 1752 and it was made law in 1753. The rules are thus: every fourth year is to be a leap year and have 29 days in the month of February, except in a centenary year when there would be no leap year. This is further modified so that there is a leap year if the centennial year is a 400th i.e. divisible by 400. Thus the year 2000 will be a leap year.

From the perpetual calendar chart it was seen that the first leap year after 1753 was 1756 and that the first of March in that year fell on a Monday. Another useful fact that will ease the calculations in our program is that the calendar repeats itself day for date every 28 years.

With the research complete a list of requirements can now be tabulated.

JUNE 1980					
SUNDAY	1	8	15	22	29
MONDAY	2	9	16	23	30
TUESDAY	3	10	17	24	
WEDNESDAY	4	11	18	25	
THURSDAY	5	16	19	26	
FRIDAY	6	17	20	27	
SATURDAY	7	18	21	28	
Input Month and Year >					

Fig.2. The designed screen format for the calendar program. Note that the prompt re-appears after each month has been produced.

1. The calendar should operate between 1756 and 9999.
2. The required month to be input in the form  
MONTH YEAR
3. The display to be in the form shown in Fig.2 with

# MACHINE CODE

weekdays on the left beginning with Sunday, and all leading zeros blanked.

4. Automatic determination of the number of days in the month, including 29th February on leap years.
5. Each month and year displayed should be titled at the top of the screen.
6. The program should be regenerative. (ie should prompt another input without the need to return to the monitor).

## Charting The Program

The next stage is to sketch out on rough paper a plan of how the program is to tackle the problem. This is best done by breaking the complete operation down into small sections that can be separately worked on and then integrated at a later date. This operation usually takes quite a long time as several attempts will be needed to determine the best solution.

The best way to present these thoughts on paper is to produce a diagrammatic summary of the procedures involved. This diagrammatic representation is known as flowcharting and consists of interlinked boxes that describe particular functions. An article in the February issue of CT gives insight into flowcharting techniques so a brief recap is all that is needed here, this is in Fig.3.

That's all for this month, but if anybody feels suitably motivated, try to produce your own flowchart for the calendar program. Next month we'll give an insight into structured program techniques and a build up of the calendar flowchart.







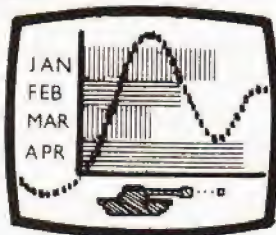
TYPE	SYMBOL	USE
LABEL		MAINLY FOR TITLE (EG START), SUBROUTINE TITLES, OR ANY MAJOR BRANCH.
PROCESS		DETAIL THE OPERATION TO BE CARRIED OUT IN GENERAL TERMS.
DECISION		THE DECISION BOX HAS ONE INPUT AND THREE POSSIBLE OUTPUTS: 'EQUAL TO', 'GREATER THAN' OR 'LESS THAN'. IT CAN ALSO BE SIMPLY YES OR NO.
INPUT		INPUT IS REQUIRED BEFORE FURTHER ACTION WILL TAKE PLACE.
PRINT		AN OUTPUT IS TO BE MADE TO A PRINTER OR VISUAL DISPLAY UNIT.
STORE		THE DETAILED INFORMATION IS TO BE STORED INTO MEMORY.

Fig.3. Typical flowcharting symbols and their uses.

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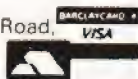
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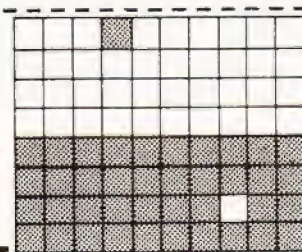
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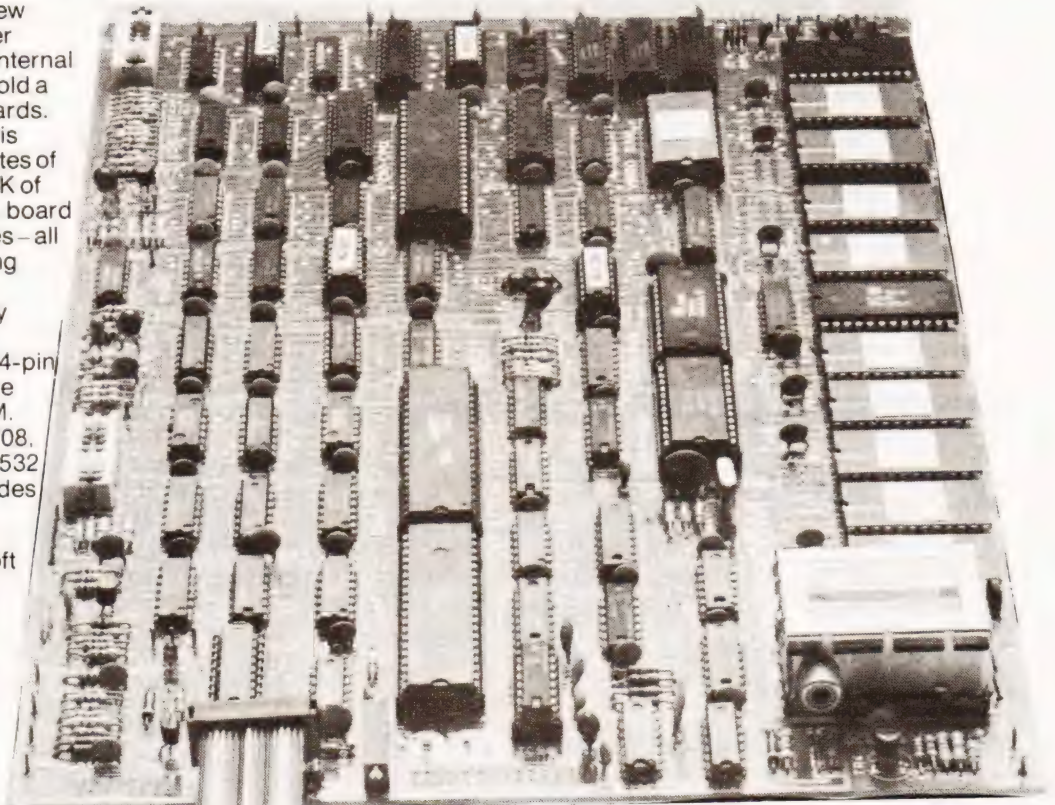
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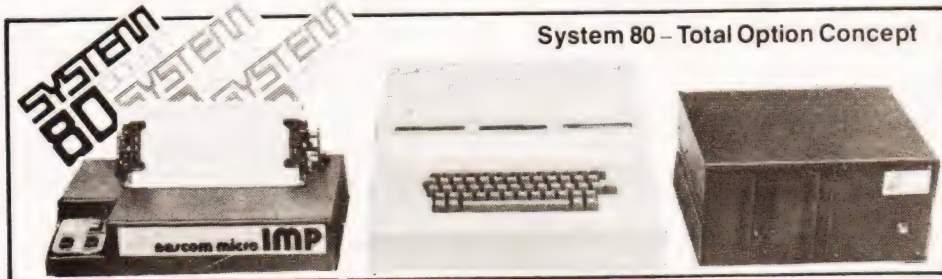
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**Keyboard:** 57-key solid state full alphanumeric QWERTY layout Licon mainframe quality keyboard with cursor control keys.  
**On board interfaces:** Domestic TV at 50Hz 625 lines (adaptable to 60Hz/525 lines) displaying 16 lines of 48 characters.  
Kansas City type audio cassette (300/1200 baud) or Teletype. RS232 for printer. 16 free, programmable P10 lines.  
**Graphics:** 2K bytes of ROM: 128 graphics characters, 128 character ASCII with full upper and lower case Alphanumerics.

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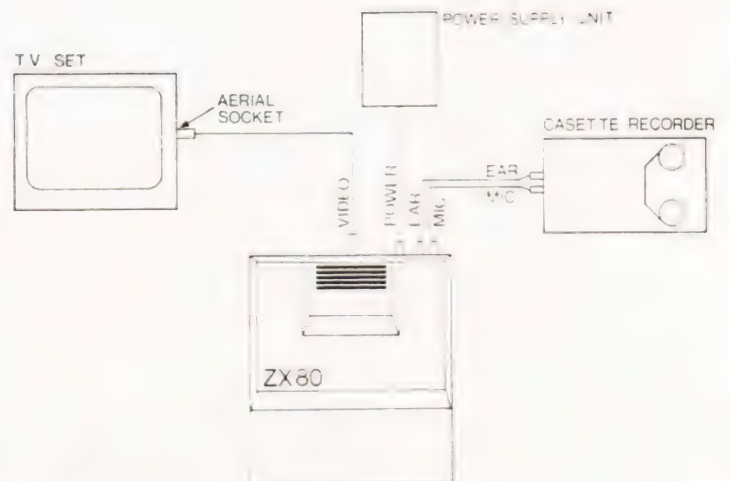
## The personal micro goes handheld. Clive Sinclairs new system comes under our eagle eye.

**B**y now every person who has access to a computer journal, or one of the electronic monthlies, such as ETI, will have heard of the new Sinclair ZX 80 micro-computer and (judging by the amount of mail) wants to know more. Rather than reviewing a prototype model, we waited until a production kit became available and then took a long hard look at the machine. This is the result of that inspection and we hope that it will enable you to decide whether the system is what you require or not.

### A Jumbled Start

As you can see from the photos of the kit there are not too many components to worry about, the parts list details all of them and it is well worthwhile checking them before construction is started. The instructions are clear and fairly concise, certainly no glaring errors, and for a reasonably competent constructor an evening should see it complete and running.

We decided to fit a switch to allow the video to be reversed at any time and it would be a useful idea to bring a push-button out in the same manner to ground the reset line: the circuit diagram is adequate for both these minor enhancements. Our kit worked first time and has not shown any signs of failing yet despite concern over the regulator, see the hardware section later.



# ZX 80 REVIEWED

## Setting Up

We had no problems with a standard black and white set, but with a rented colour TV we obtained a double (ghosted) image all the time which rendered the system unusable. The reason for fitting the switch to reverse the video was that some TVs gave a clearer picture with a conventional white on black image and some preferred the inverse type. No reason really but subjectively the author prefers white on black.

A page of notes that were included with the manual solved the minor problem with the tape interface and although it is slow it functioned without error. Overall the first impression of the system was that it was easy to build and equally easy to set up.

## Mask Of Intrigue

Being of a hardware background the author started to delve within the entrails of the machine, and soon regretted the intrusion! The circuit diagram is none too clear in its layout and so the telephone lines to Cambridge soon began to hum. The criteria appears to have been to pack as much in as there was space in the case. The system is supplied with a 4K ROM, 1K of RAM that acts as the user area, CPU scratchpad and VDU buffer.

The heart of any computer is the clock circuitry and normally this is controlled by a crystal. This is not so with the ZX 80, however, it uses an oscillator circuit based on a ceramic filter. This is quite simply not accurate enough to ensure absolute control, in my opinion. The edges are not fast enough (the Mk 14 had a crystal and that was half the price!) Secondly the expansion facilities of the system are, at the moment, totally inadequate. The maximum memory capacity for RAM is 16K and whilst that is enough for programming it is nowhere near the needs of a system which requires a disc. The ROM capacity is 4K, but it appears that by re-routing bits of the PC track you could expand this to 16K, not really practical, but possible.

The outstanding nasty is that the Z80 processor has the capability to use dynamic memory and even gives a refresh signal to synchronise the operation — this signal is used to trigger the video circuitry and because of this it will be risky to try to interface dynamic memory. Why risky? Well the mean refresh time for most dynamic RAM is about 2 mS, on the ZX 80 it would get a mean refresh at 20 mS

intervals (according to the designer) and you could even lose RAM contents because of this delay.

The keyboard is an excellent piece of design and works far better than we had dared hope after experience with the Mk 14. The legend is securely printed and has not yet shown any sign of wear, the film did lift a little in one corner but then we were trying pretty hard!

Overall conclusions on the hardware design are that the system was designed to fit in a given size of box and that expansion was to be limited, if you want to try you *must* insert buffers onto *all* the bus lines as your first task.

The second major problem is the lack of proper I/O addressing, which means you will have to be extremely careful about what you connect to what, as that address line may be performing some other task. The final problem is that the machine does not use ASCII codes, so you will be unable to connect a conventional printer or terminal without writing look-up tables to convert all the internal codes to ASCII.

## Softly Does It

We have left the VDU until now because it forms part of the firmware, rather than being a piece of hardware. The 4K "SuperROM" contains, to the best of our knowledge, an implementation of an Integer BASIC, some kind of monitor/operating system and the character set. The chaps at Nine Tiles deserve a considerable pat on the back for their valiant efforts in cramming what they have into the space available.

It is a very useable BASIC as it caters for all the normal functions and has an excellent syntax checker that is quite infuriating to use — mainly because it *is* right and you're not. It also has an excellent screen editor which is both powerful and versatile. But why provide these at the expense of better and more powerful BASIC commands?

The single keystroke programming is a much discussed feature of the ZX 80 and the author feels that he would rather type the command out than have a little routine do it for him.

Why? Because not all the single keys are associated with obvious letters and because he has got so used to typing "?" for "PRINT" and "INPUT" for "INPUT" that he has to think twice to do anything else. Any traditional programmer is likely to make the same comments — any novice will love it!





The VDU has taken more than a few knocks in the press, we found it to be adequate in definition, annoying to use when it goes blank and unnerving when it flickered (on hitting a key). Again all these comments would only be applicable to someone who is used to "other more expensive" equipment, anyone starting out with the ZX 80 would not bat an eyelid.

#### Basically Implemented

The BASIC is adequate within the limits of the machine. It will serve most of the usual requirements, bearing in mind that it can only work in whole numbers, unless you write acres of code to perform fraction routines. The next step is, in this case, down to machine code. Can you pack the RAM area with machine code? Yes, using POKE and USR, but Sinclair are not going to tell you much about the monitor routines and even less as to where they are. No mention is given in the manual as to how you access machine code, other than the fact that you POKE it and no details are given about the Z80.

#### Documenwhat?

The manual is described as a teach yourself BASIC volume, which is as accurate as a bent ruler! It may teach you to use the ZX 80, but it does not teach good or economic programming and should be instantly supplemented by a recognised

manual, such as Coan's "Basic BASIC", or Alcock's "Illustrating BASIC".

As a measure of the content it has two types of chapter, one for the experienced and one for the beginner. We suggest that *all* of you read *all* of it very carefully.

Any program that uses interactive graphics (PEEKs and POKEs on a memory mapped screen) will be unuseable on this system. Any program that uses a full BASIC will have to be modified and the reverse is also true, in that ZX 80 software will need conversion to run on other machines. The tape interface is non-standard so you can't load and dump to other machines through this medium. Much of which, of course applies to many other, much more costly, machines.

#### Expandability

The ZX 80 has a theoretical capability of 64K of RAM/ROM/IO but only 16K of this theoretical memory space is available for user expansion. This area can be partially filled with a 3K RAM board for a further £60 or, at some time in the future, by a 16K RAM board. It is *not* possible, as reported elsewhere, to piggy-back the 3K boards. The designer agreed in discussion that a mother/bufferboard would be needed if any serious expansion was to be considered. It is envisaged that Sinclair Research will produce a printer, but it is unlikely that discs will appear.



# ZX80 REVIEWED

## Appraisal

The ZX 80 is arguably the first complete system. The novice or first time programmer who has never had access to any kind of computer will be perfectly satisfied with his (or her) investment. It is unlikely that it will make anyone into a good BASIC programmer overnight, it will, however, teach the fundamentals well and for this it is highly commended.

## Pros And Cons

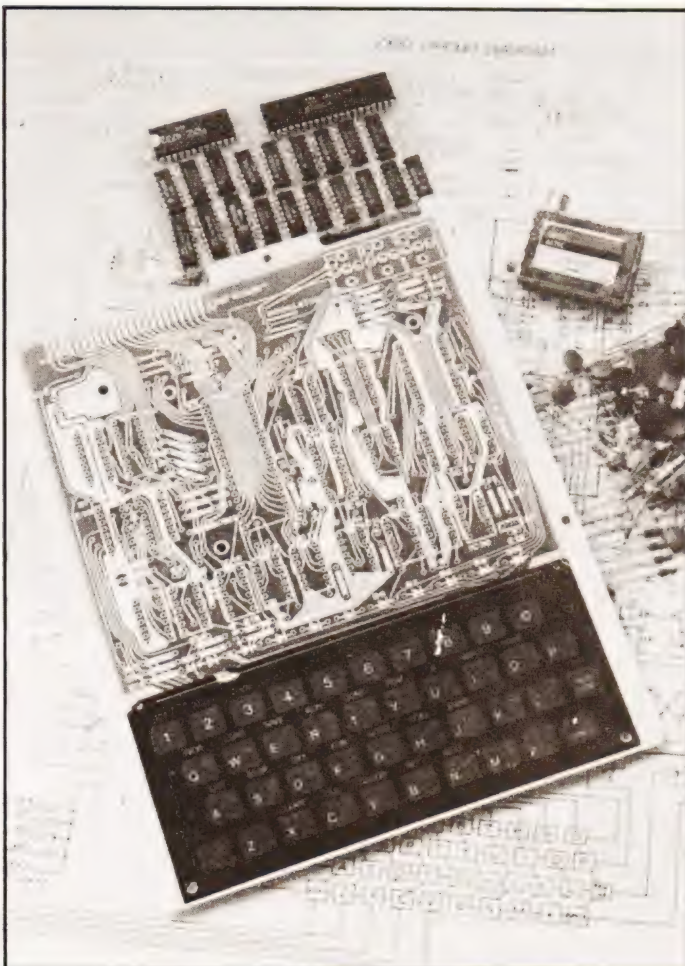
To give a brief view of the facilities we have produced a table which may give a quick overall impression.

### Pros:

Z80 CPU, with powerful instruction set for machine coders.  
 BASIC language, which is easy to learn for the rest of us.  
 Large quantities of software "free" in magazines.  
 Cheap and easy to build, with good instructions.  
 Excellent screen editor and syntax checker.  
 Good first system.

### Cons:

Lack of machine code explanation.  
 Poor BASIC manual.  
 Incompatible BASIC with only integer arithmetic.  
 Cassette format incompatible with any other system.  
 Poor expansion capability.  
 Non memory mapped display (means no graphics games).  
 Use of non-standard character codes (means no direct printer attachment).



## System Commands:

CLEAR	Clears variables
CLS	Clears screen
BREAK	Halts run and returns to command stage
EDIT	Returns current line (at pointer) to bottom of screen for editing.
LIST	Lists specified line(s) of program
STOP	Halts execution
NEW	Clears memory and awaits new program
LOAD	Loads from cassette interface
SAVE	Writes current program to cassette interface
RUN	Executes current program
CONT	Continues STOPped program
HOME	Moves cursor to top line of program list
RUBOUT	Deletes character to left of cursor

## Statements:

REM	Allows inclusion of text for comments
IF	Comparative
INPUT	Assigns value of keyboard input to variable
PRINT	Prints specified variable to the TV screen
DIM	Dimensions array size
FOR	Used in conjunction with NEXT to execute a defined loop
NEXT	Returns to FOR statement if loop counter not full
GOTO	Jumps to specified statement
POKE	Places assigned value in defined memory location, used in machine code programming
PEEK *	Returns value of specified memory location
GOSUB	Jumps to defined subroutine
RETURN	Returns to main program from subroutine
LET	Assigns specified value to specified variable
RANDOMIZE	Resets seed value of random number generator
NOT, AND, THEN, TO	Comparative "tokens"
CHR\$ *	Produces the character whose code is specified
STR\$ *	Produces the decimal value of the specified string
TL\$ *	Returns the specified string less the first character
CODE *	Produces the code for the first character in a specified string
RND *	Generates a pseudo-random number within defined range
USR *	Calls machine code routine located at address specified
ABS *	Returns absolute value of specified variable

Table 1. The BASIC functions as implemented on the ZX80, all available at a single keystroke except those marked \*.

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**LM 381 Preamp Design** — Design IC preamps with this low-noise integrated circuit.

This package will reduce your designing time and let you build those circuits fast. Order No. 0008R

**HAM PACKAGE I** This versatile package lets you solve many of the commonly encountered problems in electronics design. With your

**SPACE TREK IV** Trade or wage war on a planetary scale. This package includes:

**Stellar Wars** — Engage and destroy Tie fighters in your attack on the Death Star. For one player.

**Population Simulation** — A two-player game where you control the economy of two neighbouring planets.

You decide, guns or butter, with your TRS-80 Level II 16K. Order No. 0034R

**RAMROM PATROL/TIE FIGHTER/KLINGON CAPTURE** Buck Rogers never had it so good. Engage in extraterrestrial warfare with:

**RAMROM PATROL** Buck Rogers never had it so good. Engage in extraterrestrial warfare with:

**Ramrom Patrol** — Destroy the Ramrom ships before they capture you.

**Tie Fighter** — Destroy the enemy Tie fighters and become a hero of the rebellion.

**Klingon Capture** — You must capture the Klingon ship intact. It's you and your TRS-80 Level II 16K battling across the galaxy. Order No. 0028R

**CARDS** This one-player package will let you play cards with your TRS-80 — talk about a poker face!

**Draw and Stud Poker** — These two pro-

grams will keep your game sharp.

**No-Trump Bridge** — Play this popular game with your computer and develop your strategy.

This package's name says it all. Requires a TRS-80 Level II 16K. Order No. 0063R

**HOUSEHOLD ACCOUNTANT** Let your TRS-80 help you out with many of your daily household calculations. Save time and money with these fine programs:

**Budget and Expense Analysis** — You can change budgeting into a more pleasant job with this program. With nine sections for income and expenses and the option for one- and three-month review or year totals, you can see where your money is going.

**Life Insurance Cost Comparison** — Compare the cost of various life insurance policies. Find out the difference in price between term and whole life. This program can store and display up to six different results.

**Datebook** — Record all those important dates in your life for fast, easy access. The program has all major holidays already included.

All you need is TRS-80 Level II 16K. Order No. 0069R

## PET

**CASINO I** These two programs are so good, you can use them to check out and debug your own gambling system!

**Roulette** — Pick your number and place your bet with the computer version of this casino game. For one player.

**Blackjack** — Try out this version of the popular card game before you go out and risk your money on your own "surefire" system. For one player.

This package requires a PET with 8K. Order No. 0014P

**CASINO II** This craps program is so good, it's the next best thing to being in Las Vegas or Atlantic City. It will not only play the game with you, but also will teach you how to play the odds and make the best bets. A one player game, it requires a PET 8K. Order No. 0015P

**CHECKERS/BACCARAT** Play two old favorites with your PET.

**Checkers** — Let your PET be your ever-ready opponent in this computer-based checkers program.

**Baccarat** — You have both Casino- and Blackjack-style games in this realistic program.

Your PET with 8K will offer challenging play anytime you want. Order No. 0022P

**MIMIC Test** your memory and reflexes with the five different versions of this game. You must match the sequence and location of signals displayed by your PET. This one-player program includes optional sound effects with the PET 8K. Order No. 0039P

**TREK-X Command the Enterprise** as you scour the quadrant for enemy warships. This package not only has superb graphics, but also includes programming for optional sound effects. A one-player game for the PET 8K. Order No. 0032P

**TURF AND TARGET** Whether on the field or in the air, you'll have fun with Turf and Target package. Included are:

**Quarterback** — You're the quarterback as you try to get the pigskin over the goal line. You can pass, punt, hand off, and see the results of your play using the PET's superb graphics.

**Soccer II** — Play the fast-action game of soccer with four playing options. The computer can play itself, play a single player, two players with computer assistance, and two players without help.

**Shoot** — You're the hunter as you try to shoot the bird out of the air. The PET will keep score.

**Target** — Use the numeric keypad to shoot your puck into the hom position as fast as you can.

To run and score all you'll need is a PET with 8K. Order No. 0097P

**ARCADE I** This package combines an exciting outdoors sport with one of America's most popular indoor sports:

**Kite Fight** — It's a national sport in India. After you and a friend have spent several hours manoeuvring your kites across the screen of your PET, you'll know why!

**Pinball** — By far the finest use of the PET's exceptional graphics capabilities we've ever seen, and a heck of a lot of fun to play to boot.

Requires an 8K PET. Order No. 0074P

**ARCADE II** One challenging memory game and two fast-paced action games make this one package the whole family will enjoy for some time to come. Package includes:

**UFO** — Catch the elusive UFO before it hits the ground!

**Hit** — Better than a skeet shoot. The target remains stationary, but you're moving all over the place.

**Blockade** — A two-player game that combines strategy and fast reflexes.

Requires 8K PET. Order No. 0045P

**DUNGEON OF DEATH** Battle evil demons, cast magic spells, and accumulate great wealth as you search for the Holy Grail. You'll have

to descend into the Dungeon of Death and grope through the suffocating darkness. If you survive, glory and treasure are yours. For the PET 8K. Order No. 0064P

## Apple

**MATH TUTOR I** Parents, teachers, students, now you can turn your Apple computer into a mathematics tutor. Your children or students can begin to enjoy their math lessons with these programs:

**Hanging** — Perfect your skill with decimal numbers while you try to cheat the hangman.

**Spellbinder** — Cast spells against a competing magician as you practice working with fractions.

**Whole Space** — While you exercise your skill at using whole numbers your ship attacks the enemy planet and destroys alien spacecraft.

All programs have varying levels of difficulty. All you need is Applesoft II with your Apple II 24K. Order No. 0073A

**MATH TUTOR II** Your Apple computer can go beyond game playing and become a mathematics tutor for your children. Using the technique of immediate positive reinforcement, you can make math fun with:

**Car Jump** — Reinforce the concept of calculating area while having fun making your car jump over the ramps.

**Robot Duel** — Practice figuring volumes of various containers while your robot fights against the computer's mechanical man.

**Sub Attack** — Take the mystery out of working with percentages as your submarine sneaks into the harbor and destroys the enemy fleet.

All you need is Applesoft II with your Apple II and 20K. Order No. 0098A

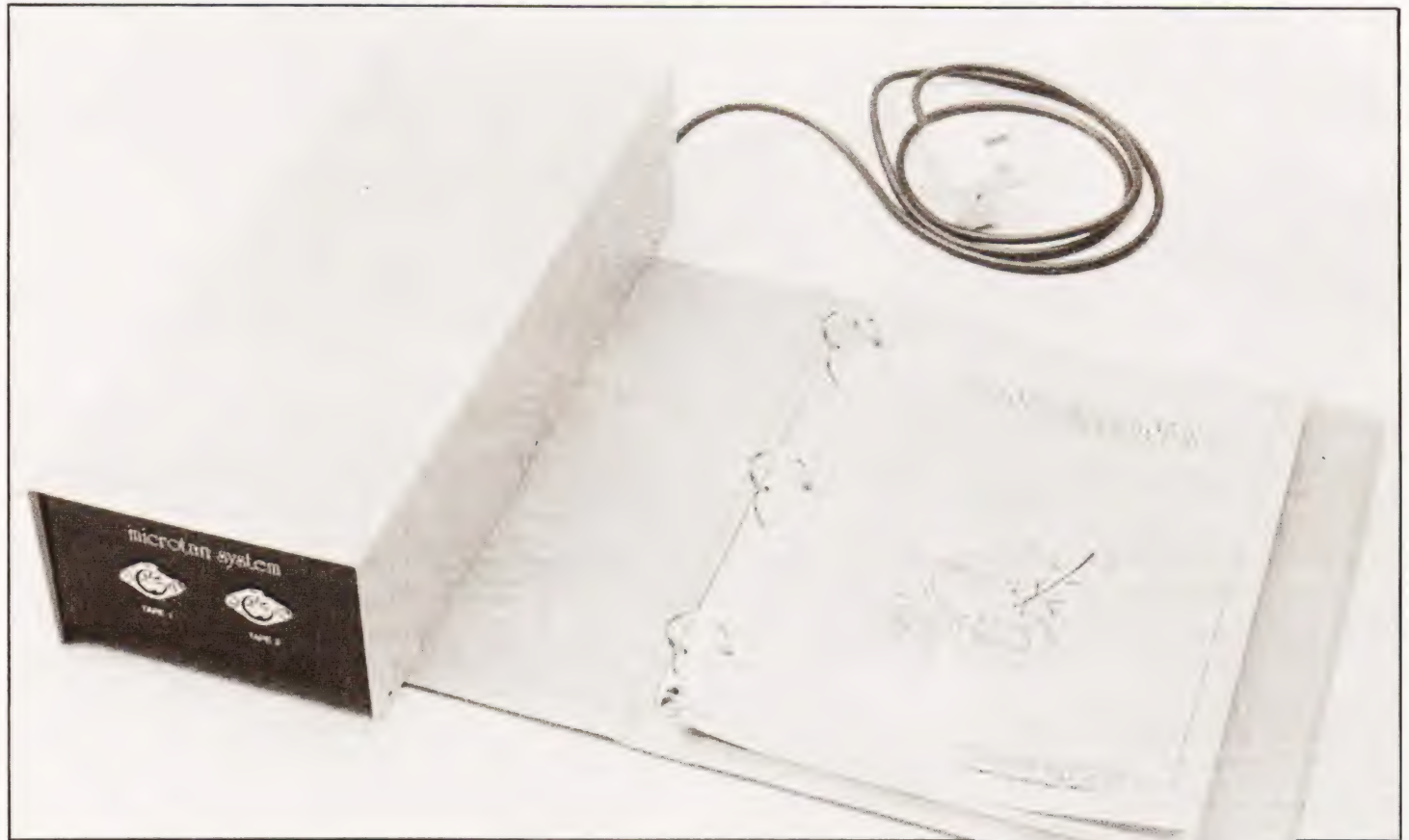
**GOLF** Without leaving the comfort of your chair, you can enjoy a computerized 18 holes of golf with a complete choice of clubs and shooting angles. You need never cancel this game because of rain. One or two players can enjoy this game on the Apple with Applesoft II and 20K. Order No. 0018A

**BOWLING/TRILOGY** Enjoy two of America's favorite games transformed into programs for your Apple:

**Bowling** — Up to four players can bowl while the Apple sets up the pins and keeps score. Requires Applesoft II.

**Trilogy** — This program can be anything from a simple game of tic-tac-toe to an exercise in deductive logic. For one player.

This fun-filled package requires an Apple with 20K. Order No. 0040A



**Just another 6502 system? We think not. Microtan's expandability is almost second to none and it could be a winner.**

**T**he ideal system in most people's minds is one that is as cheap as possible, provides the most facilities, is expandable to the limits of its design and can be obtained piece by piece as the money is saved. Up to now there have been several systems that have sought to achieve these varied aims, and the results have been many and varied.

The machine reviewed here is another contender in this field and certainly seems to be set for success where others have not. Based on the 6502 CPU, the same chip as used in PET and Apple among others, it has several very interesting items to offer.

**Concept Of A System**

The usefulness of a computer on a board is limited, the usefulness of a system with attendant peripherals is much greater. The ideal balance is struck when the single board can become part of a system and thus have the capability of fulfilling the needs of both markets.

Microtan has been designed in this way, the complete system has been planned and is then offered board by board. This review is only going to cover the basic board but mention will be made of the available expansion to construct the

system. Table 1 gives details of the various stages that are available, in their various configured forms.

**Assembly Or Assembled?**

I built the Microtan from a kit, something that I believe is worth doing as you not only save money but you do get an insight into how the hardware is strung together. Presentation is superb and to anyone who is competent with a soldering iron this should represent no more than an evening's work. Please note that the PCB is double sided *and* through-hole-plated so you must use a fine tip on the iron and fine solder otherwise you will have problems.

The manual that is supplied covers all the areas needed to construct the kit and get it up and running. It covers other areas that I will mention later. The only serious omission is the lack of a circuit diagram, but this is being rectified I gather. You will need a power supply, the 5 volt supply that we published in CT serves admirably or you can buy one from Tangerine.

The true test of any kit is whether it works, it did in its basic format and with the graphics option in place but it died when I tried to add the lower case option. Immediate

# MICROTAN 65 REVIEW

Board : Microtan 65

Features : 6502, 1K RAM, 1K ROM, 6 I/O ports

Options : Pixel graphics, lower case alphas, address bus buffers.

Need to run : TV, Hex keypad, 5 V PSU @ 1 A

Board : Tanex

Features : 1K RAM, 16 parallel I/O, TTL serial I/O, cassette I/O, 2 by 16 bit counter timers, full memory map, data bus buffers.

Options : 6K RAM, 4K ROM, 10K Microsoft BASIC, double above I/O plus RS232/20 mA serial with full modem control.

Need to run : ASCII keyboard, ±12 volts.

Board : Tanram

Features : 40K mixed static and dynamic RAM

Board : Tandisc

Features : control of four drives

Extras : Motherboard, case, power supply, Hex keypad, ASCII keyboard.

Table 1. The various system configurations for Microtan.

Monitor command	Function
M(add)(term)	Modify memory locations, terminator type allows step through, cancel or jump out.
L(add),(numb)(term)	Lists the contents of specified memory locations in tabular form.
G(add)(term)	Sets internal registers and executes program at address given. NB cursor disappears.
R	Sets memory modify command to register mode. Allows the 6502s internal registers to be altered.
S	Sets single step mode, see P and N
N	Resets to normal mode from single step
P	Causes monitor to execute next instruction, can be set to execute n instructions. Gives display of all registers and returns to monitor.
B(add),(numb)(term)	Sets breakpoint at specified address, up to eight are allowed. All registers are displayed and P command may be used to continue.
O(branch add)(dest add)(term)	Calculates offsets between specified addresses for use in branch arguments.
C(start add)(end add)(start add dest)(term)	Copies memory locations and blocks.
NB (term) can be CR, LF or SP.	

Table 2. The available monitor commands on Tanbug.

Right: The author's system growing inside a Vero rack.

thoughts of dead ROMs were not correct, the eventual culprit was a tri-state device that was permanently tri-stated. Quick work by Tangerine meant that I was back on the screen before the postman had called twice.

## Micro Monitor

The old question of "How much can you fit into a pint pot?" rears its ugly head with Tanbug, the 1K monitor supplied as standard. The answer in this case is "Enough!". At this stage you have a system that can only deal with machine code and a glance at Table 2 will show that there is only one possible omission from the monitor, that of cassette handling. Well, you don't have a cassette interface yet so what are you worrying about? If you are going to expand to Tanex, which has that necessary interface, you get the routine for handling named files which you can either load up yourself or get in an EPROM that plugs in to a socket and is called through Tanbug. The cassette handling is at a choice of 300 or 4800 Baud so you can't even boil the kettle let alone drink a cup of coffee while loading programs.

What does Tanbug have that sets it apart from other monitors? Two things really, you get a full listing of the firmware with notes and explanations and you *don't* get any bugs, at least I haven't found any yet. It does all that the Microtan user will require and if you ever get big enough to warrant it there is a bigger version called XBUG lurking in a dark corner.

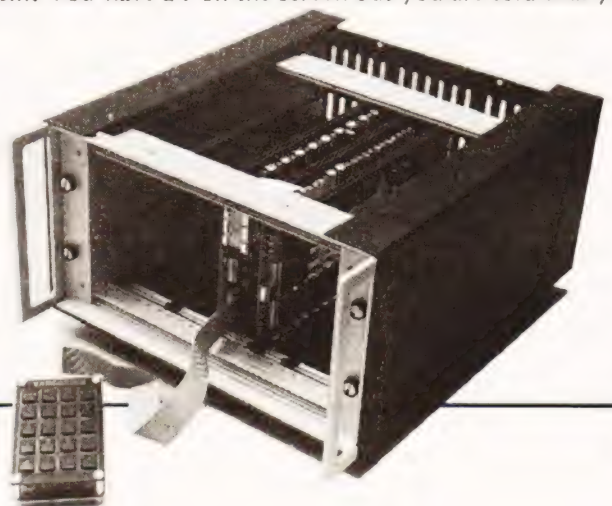
## Manual Means Handy?

The little orange covered book that is supplied is worthy of a mention in its own right. OK, it's not perfect but it is detailed and concise. One or two errors have escaped correction but nothing that will cause the crashing of programs or other damage. The book fits into a ring binder and will be joined by the manuals for Tanex and the other family members, a neat concept in its own way.

For a change the manual is logical, it explains the concept of the board, then the system, then the details of the 6502 with the complete instruction set and then a very detailed chapter on the monitor and its uses — complete with the listing and finally it gives you a couple of games. It is essential to read the whole thing through from cover to cover before starting to play, the unit is complex and should be understood before anything is attempted.

## What You Get

Once the board is built and the manual read you are ready to go. All you need now is a black and white TV and a 5 volt power supply at about 1 amp. Connect up, turn on and hit reset. The screen is covered in a pretty pattern with the words TANBUG at the bottom followed by a prompt character. At this point we find the only serious problem with the system. You have a ? on the screen but you are told that you



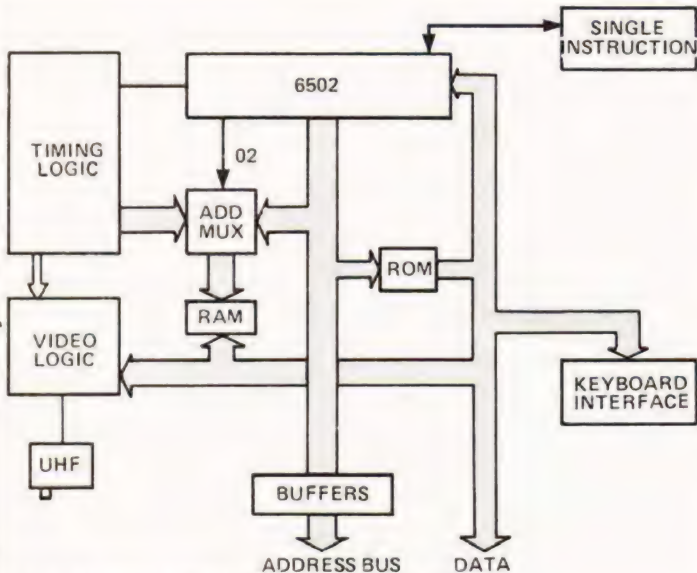


Fig.1. Microtan's architecture, all on one board too!

should have a square blob, have you blown it up? No, you haven't got the lower case option. It is explained in the manual but it is very unclear and has caused much confusion and alarm both in the office and outside.

So, you have a working system. Machine code programmers can now go and have a ball, the rest of us start learning. If you are a dedicated BASIC person Tanex is a must, throw away the Hex keypad (superb thought it is), plug in the full ASCII, the system works out which you are using, and let yourself go with a 10K Microsoft BASIC.

Points worth of note, and praise, are the rock steady display on your TV, the VDU RAM is only accessed when the system RAM is not so you don't get the usual flicker, the excellent Hex keypad and the almost unbelievable packing density. Because the system is based around the 6502 comparisons with the Acorn, reviewed in August '79, are almost inevitable. With Microtan you get a proper VDU as opposed to an LED display, a decent keypad that is separate and a slightly more powerful monitor but you do lose the cassette (at this stage).

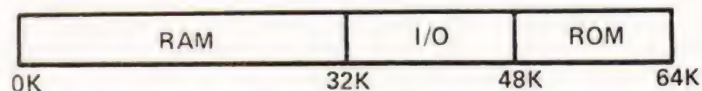


Fig.2. The simple memory map produced by Microtan.

### The Guts Of The Matter

Because of a lack of space on the board certain apparently ignored features are implemented at other points in the system. Figure 1 shows the architecture of the board, the keyboard interface is intelligent in that it detects what type is being used. The memory map of the system, see Fig.2, appears to be rather limited, full decoding is done on the Tanex board and gives the map shown in Figure 3. This is not the disadvantage that it might appear to be, it allows the contents of RAM on Microtan to be protected against DMA as are the I/O ports and the ROM area. Whilst on the subject of I/O it is worth noting that you get a 1K area that is addressable as I/O, this compares with a maximum of 256 on devices using the Z80 or 8080.

The system expansion is shown in Figure 4, full details of the bus structure are given along with notes for DIY people. The address bus buffer chips are supplied as part of the Tanex unit, so don't worry about the empty sockets.

MEMORY ADDRESS	FUNCTION
FFFF	1K ROM (TANBUG)
FC00	
FBFF	(TANBUG REFLECTED -1K)
F800	
F7FF	4K ROM ON TANEX
F000	
EFFF	
E800	10K BASIC INTERPRETER ON TANEX
E7FF	
E000	
DFFF	
D000	
CFFF	BFFF - BFFF MICROTAN 65 I/O
C000	
BFFF	SPARE I/O PORTS
BC00	
3BFF	40K RAM TANRAM
2000	
1FFE	7K RAM ON TANEX
0400	
03FF	1K RAM ON MICROTAN 65
0000	

Fig.3. Once you've added Tanex you get a proper memory map, which is fairly impressive.

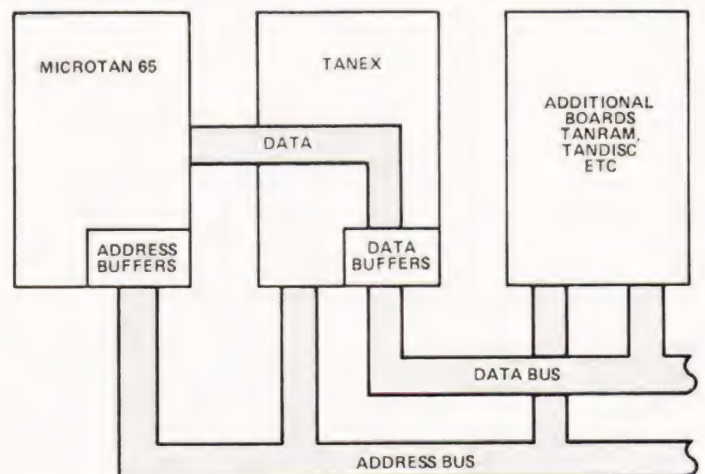
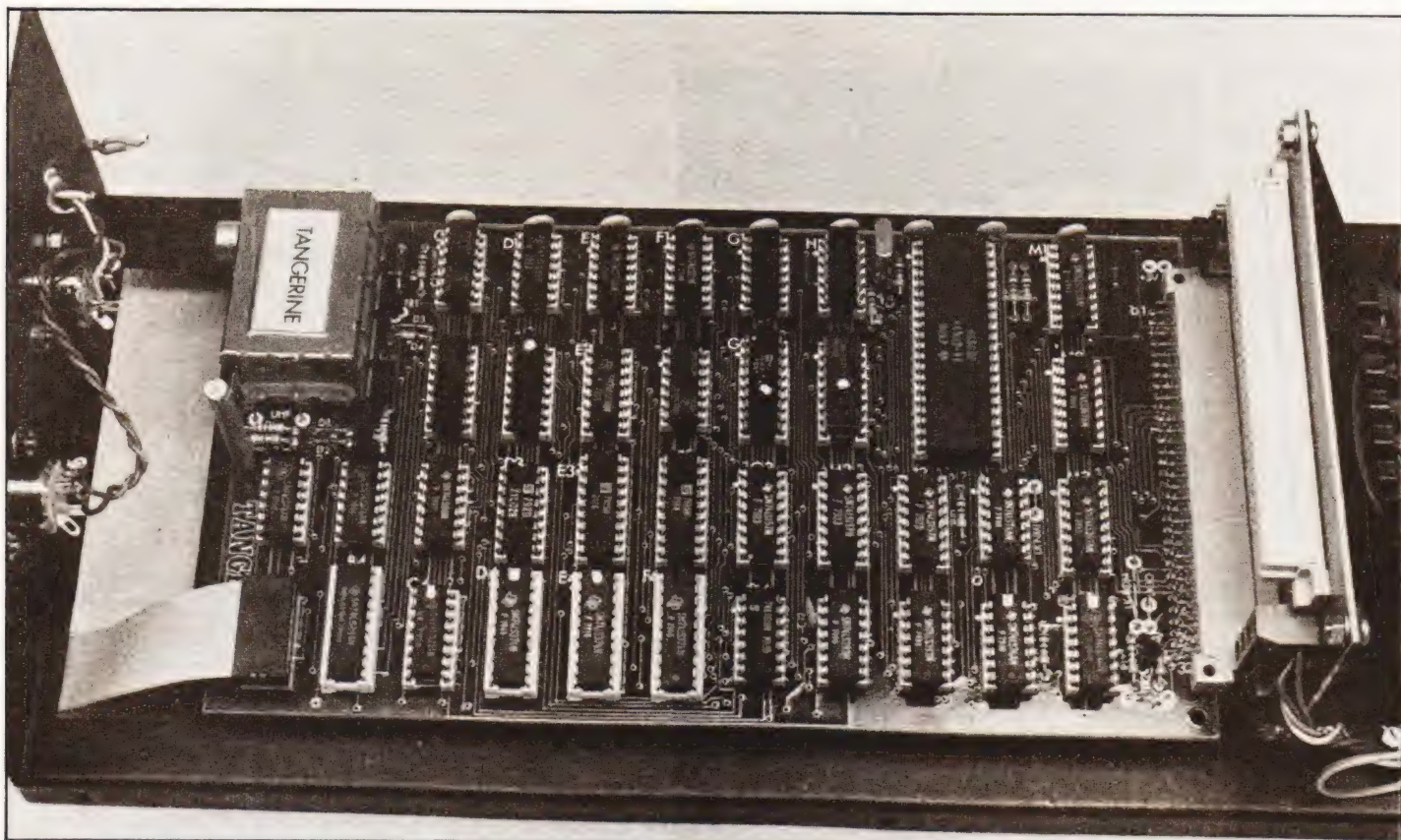


Fig.4. How you expand through Tanbus.

### On Board Options

Despite the fact that the basic Microtan packs in a 6502, keyboard interface, VDU, 1K of RAM and 1K of monitor ROM there is more to come! As seen from the previously mentioned Fig.4 the address bus buffers fit on, but that's not the end. You can have lower case alphabetic, not essential at this stage, and pixel type graphics, sometimes called "high resolution" but really made up of little squares not dots.

# MICROTAN 65 REVIEW



The Microtan board installed in the mini-rack.

Tangerine are quite honest about them and call them "Chunky" which is a very apt description, they are good enough for Teletext simulations and games etc.

Because of the ingenious VDU design it is quite possible to run a program that actually resides in the screen memory without bombing everything, try that on your system.

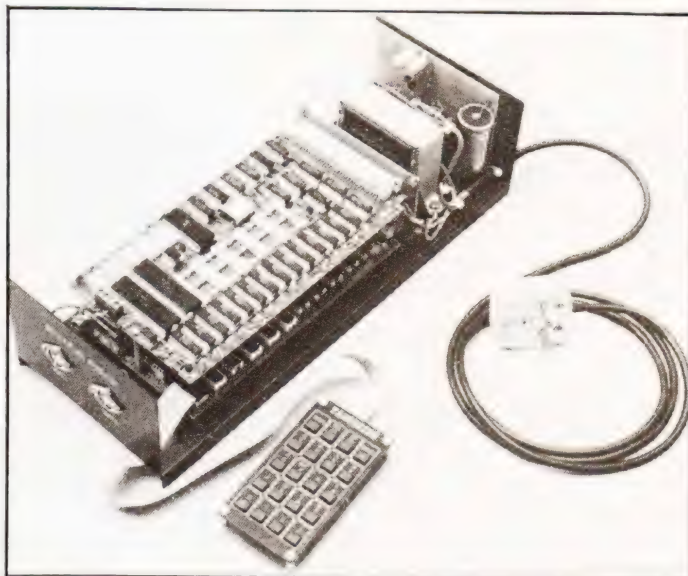
## Expanding Horizons

Glancing back to Table 1 you can see the basis of your system emerging. The rest is coming shortly and completes the story. Tanram will be the next board to go on sale and offers 40K of memory on a single board and this will have the capability of bank selection so RAM freaks can have the odd megabyte or six if they want. You may have realised that the system is now full, see Fig.3. Next on the stocks is Tandisc, offering you the floppies that you dream of, up to four double density units are planned.

Housing all this exotic hardware need not be a problem either, the case that Tangerine supply will hold Microtan and Tanex complete with power supply. The other style that you could use is a card frame, I am building my system in a Vero unit, assembled from System KM4C parts which also offer such goodies as front panels and modules. However you could design your system to fit into a VDU case and have a self-contained system, it's up to you.

## Summing Up

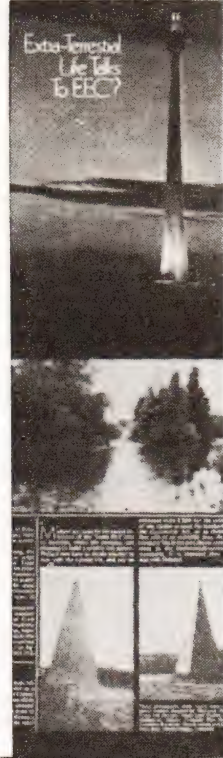
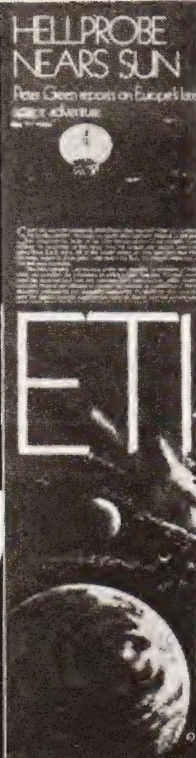
Microtan, and its attendant extras, offer the first time buyer a low cost entry point into computing. Taking a boxed two-board system with *all* the options, power supply and key-



Tanex fits on top in the mini-rack system, along with the power supply and the Hex keyboard.

board you have a more powerful unit than a PET, it has more I/O capability and at £350 it is a lot cheaper!

The product appears to have been launched with a great deal of thought and planning, in itself a change from some rivals, and seems to have found a niche in the market almost overnight. The only thing it hasn't got is a "second generation" CPU such as a Z80 or 6809 but that doesn't seem to be too much of a handicap, the dedicated machine code programmers among you might disagree but no-one else has!



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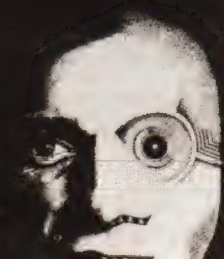
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# computing today

**WHAT TO LOOK FOR IN  
OUR JULY ISSUE, ON  
SALE JUNE 13TH.**

## COMPUCOLOUR REPORT

The Compucolour II never really took off in this country despite the glowing reviews it received. As a colour graphics machine it offers a variety of functions that are both unique and powerful and our users report contains a detailed discourse in the machines defence. It also provides an interesting insight into the problems that can occur when you try and order machines from abroad, caveat emptor has seldom been more applicable!

Are you hexed about Hex? Do you know what to do with it when you've got it? Read how one of our readers struggled through the Hex jungle and emerged triumphant with the knowledge. Seriously though, if you are having problems understanding how to link machine code routines to BASIC programs then this is a must for you. TRS-80 owners are advised to queue for this issue as it is going to be much in demand!

## HEX A TRUSTY 80

## MAILING LIST PROGRAM

Is your tongue fed up with sticking all those stamps, envelopes and things? Use CTs mailing list implementation as the basis for your small business, office, club, user group etc etc and save your secretary that feeling of "gummy tongue".

Computerisation and the classroom are thorny subjects but there is a real and ready-made application in the multiple choice type of exam. Our regular contributor, A.P. Stephenson, presents his ideas and programs on this subject. Book your classroom micro for a test with next months educational CT.

## TAKE A TEST

## UART PROJECT

This month we present a companion board to the popular modem project with our UART board. Simple, powerful and flexible were the requirements and that's exactly what it is - so if you have interfacing problems connect to the next issue.

## Although this system represents a DIY start to \$100 computing it may not be the best value for money. CT reveals the inner secrets.

**T**he Explorer 85 from Newtronics Research and Development Ltd, USA, (the people who brought you the ELF II, reviewed in CT October 1979) has been available in this country for some time. It has, to date, attracted little attention. It is based on the 8085A processor – very similar to the 8080 and software compatible with that popular device. The CPU board is 13¼" x 10¾" and of a high standard of manufacture being glass epoxy, double sided, through hole plates, silk-screened and solder masked (phew!). Fully expanded it can cope with six \$100 boards. On board expansion is supplied as various "Levels". The UK distributors will supply each level separately but do a "special" consisting of levels A, B and D. The actual constituents of each level and what happened to level C will become clear later. A further mention of the board is worthwhile because all the spare space is filled with little perforations – ideal for doing your own thing in.

### Level Headed

Although the Explorer is available built, tested, cased etc etc, I had the kit version consisting of levels A, B & D. Each level is complete with its own assembly manual and description. In general the assembly instructions were clear and concise. Construction is made easier by the provision of sockets for most of the ICs.

It is worth taking time over the construction as mistakes are more easily prevented than detected (thought for the month) and there are plenty of joints to make mistakes on. I did start to calculate how many solder joints I had made but it made my brain hurt, so suffice it to say it's a lot. Despite this the only real problem I encountered was that the silk screened component positions were sometimes ambiguous. Rather than tossing a coin I used the circuit diagram provided to clear up any doubts as to what went where. Also in working from the assembly drawing I noticed that to astound and confuse presumably R144 had been omitted. I eventually found the position using the legends on the board. Although the UK distributors will rescue constructors with problems anyone in doubt about their ability to build the kit would be wise to splash out the extra cash on a ready-built version.

Level A provides 2K monitor, 256 bytes of RAM four 8 bit and one 6 bit I/O port, 14 bit clock/counter and interfaces to RS232 or 20 mA terminal, cassette and printer. No buffers are provided for the latter but spaces for suitable devices are present. A remote switch for the cassette recorder motor is on board. A version with monitor ROM to operate a Hex keyboard and display is available. A user interrupt and reset switch are also incorporated on the board.

Level B is the buffer/driver/address decoder hardware for both the on board expansion (levels D & E) and up to six \$100 boards.

Level D is 4K of RAM in the form of 8 2114's. This can be located anywhere in the address space 0000 to EFFF. F000 to FFFF being used by the system ROM.



Level E consists of sockets and voltage regulator to enable 8K of 2716's to be installed. If required these EPROMs may be replaced by pin compatible RAMs.

It is a hardware feature of the Explorer that each expansion has its own voltage regulator to minimise any problems due to excessive drain or surges to any part of the system.

### Above C Level

Further expansion is not possible on board so the only way to go is up. Pads for 2 \$100 connectors are provided in which two boards can be mounted vertically. Alternatively the level C motherboard can be bolted on to the main board, picking up the bus from one of the connectors. This enables six \$100 boards to be accommodated in total – five on the motherboard and one in the spare connector on the main board. I understand that Newtronics now have the North Star Disc system operational for the Explorer.

### Documentation

The construction details given in the manuals are good. They start with a description of what the plastic bag full of bits is going to do. There is then a check list of parts down to the last nut and bolt. Resistor colour codes as well as their values are given in this section. The actual constructional instructions are clear, concise and follow simple short steps. This means that by ticking off each instruction as it's completed, disastrous errors caused by distractions and interruptions can be averted.

The manuals contain a minimum of extra details but the level A instructions include details of how to use the monitor commands and gives an example of how an idea gets to be a program and how a program makes things happen.

# EXPLORER 85

The example requires the connection of a loudspeaker to an output port which is made to produce a 1 kHz tone for 5 seconds.

Overall I found the package was let down by the presentation of the documentation and scarcity of extra (although some may say unnecessary) information, for example block diagrams and I/O implementation.

I notice that an Intel 8085A users manual is available from the distributors and this would probably be worth considering in view of the dearth of information provided.

## Firmware

The monitor resides in 2K of ROM from F000. Two versions are available, one for RS232 or 2 mA peripherals and one to run from a Hex keypad/display. As the RS232 version is the most complete, I intend to ignore the Hex version.

Full details of the commands are given in Table 1. There is not much of special interest here but a few points are worth a mention.

The terminal width can be set by altering location F8FA or F8F6 — the manual seems a little confused here (F8FA gets my vote as it's mentioned 3 times as opposed to F8F6 only once.)

Sending a "space" from the terminal to the machine automatically sets the Explorer to the terminal's baud rate.

The tape load and save commands are straightforward enough but as the manuals warn some juggling with controls could be necessary to get good loads first time. On loading a parity check of each byte is carried out and a failure

causes the cut off of the tape's motor and an error message to be printed. This either means that you are trying to load "Semprini and his Silver Strings play The Sex Pistols' greatest Hits" or you've got a problem somewhere along the line. Obvious candidates are magnetised, or dirty head, shoddy tape or simply that the program was not saved correctly. No verify command is available in the monitor so it would be wise to set up the tape and make sure it's working before keying in that 56K "Star Trek Meets the Supreme Commander" program.

A useful addition to the tape routines is the ability to give programs headers when recording them and search when loading.

Inputting any character other than 0-9 or A-F when the machine is looking for a hex number results in the error symbol (\*) being displayed. The monitor does not provide for breakpoints but this is a minor grumble over what appears to be an adequate monitor.

## Wares Of The Soft Kind

The 8085A is completely software compatible with the 8080, the real difference being in the speed and the addition on the 8085 of serial ports and the instructions to handle them, so all your favourite 8080 programs can be run on the Explorer. As previously mentioned a North Star disc system can be hooked up to the Explorer opening up the realms of CP/M.

Microsoft 8K BASIC 80 is available in ROM or on cassette for the Explorer but as there have been so many

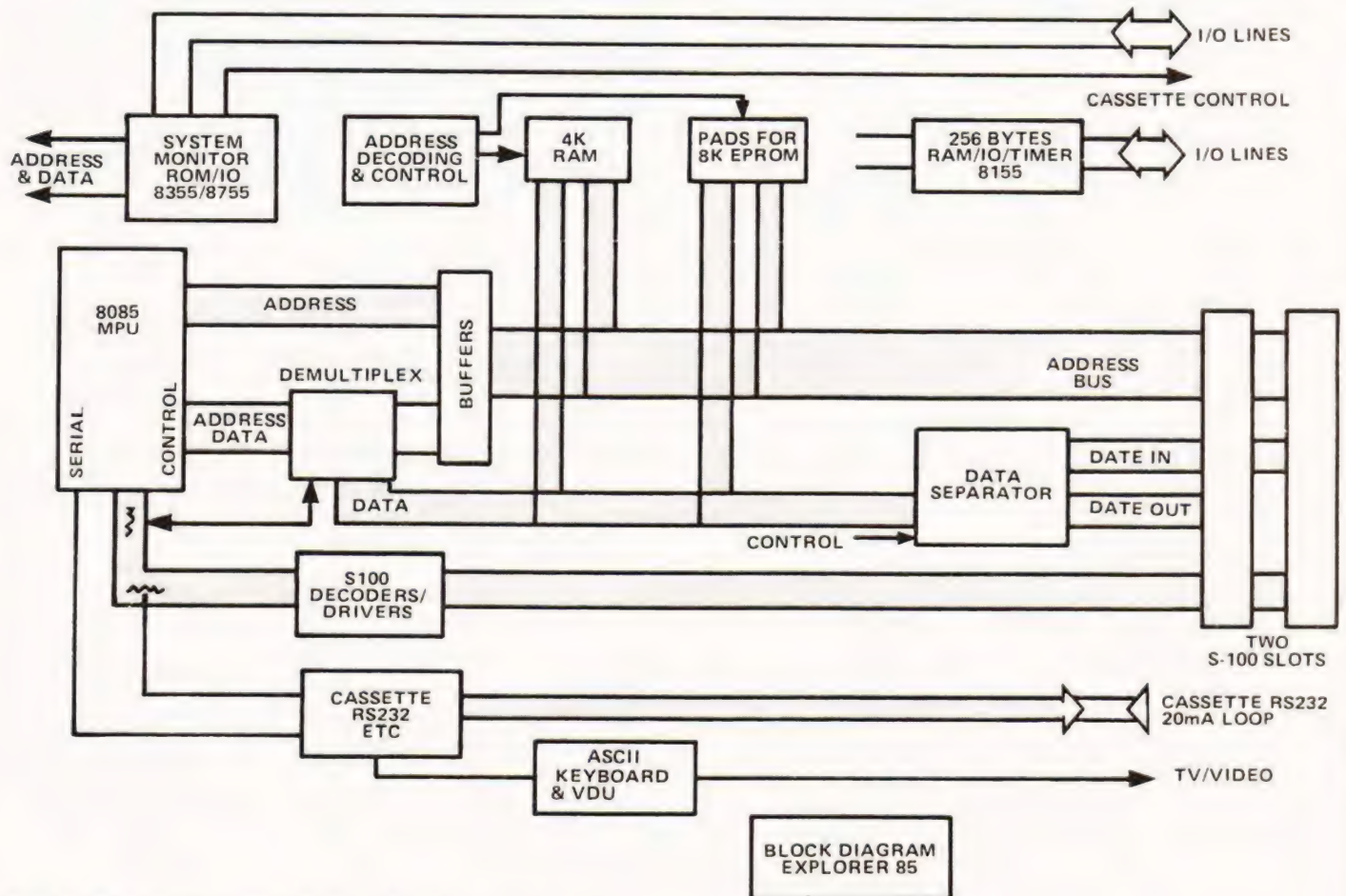


Figure 1. Block diagram of the Explorer 85, quite standard really.

# EXPLORER 85

## EXPLORER 85 MONITOR COMMANDS

Command Name	Instruction	Format	Explanation
CHANGE	C	C(location)	Modifies contents of memory location. Pressing space bar causes Explorer to display contents of memory specified and it can be replaced by typing byte in Hex. This followed by space bar causes next location to be displayed. Carriage Return (C.R.) terminates instruction.
FILL	F	F(from),(to),(byte)	Writes (byte) specified to block of memory given
DISPLAY	D	D(from),(to)	Displays contents of specified locations. Either 8 or 16 locations per line of display depending on terminal width
MOVE	M	M(from),(to),(new start)	Writes specified block of memory to block starting at specified address.
INSERT	I	I(from)	Allows for insertion of strings of data each byte separated by comma, space, CR or solidus, ESC or non-Hex character exits from command
EXAMINE	X	X(reg code)	Displays contents of specified register
		X(CR)	Examine contents of all registers.
STEP	S	S(from)	Single step from specified instruction
		S(CR)	Single step from instruction indicated by Program Counter. Space bar causes next step to be executed. CR causes next step to be executed and register contents displayed.
GO	G	G(from)	Execute program from specified address.
		G(CR)	Execute program from address specified by PC.
RECORD	R	R(from),(to),(byte)	Dumps to tape contents of specified block giving it the header (byte).
LOAD	L	L(byte)	Searches for program (byte) and loads it with parity check.

Note : Address are all 2 byte hex Nos. (byte) refers to any 1 byte hex No.

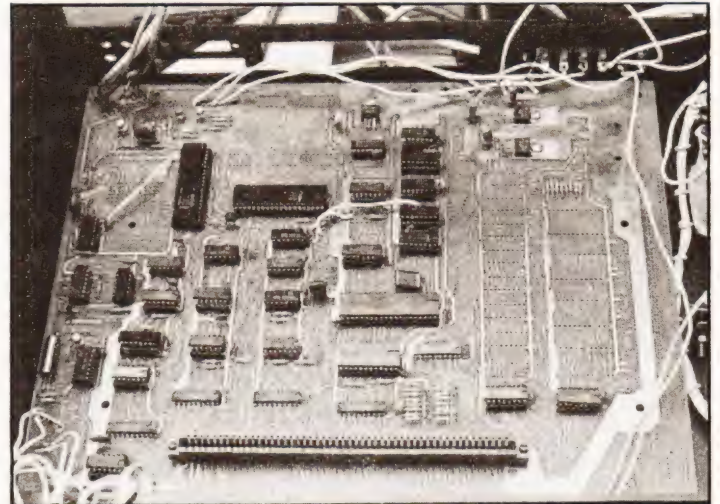
Reg Codes : A = Accumulator B to E and H & L the appropriate register  
F = Processor Flags I = Interrupt status & Mask.  
S = Stack Pointer P = Program Counter

**Table 1. The monitor commands that are available.**

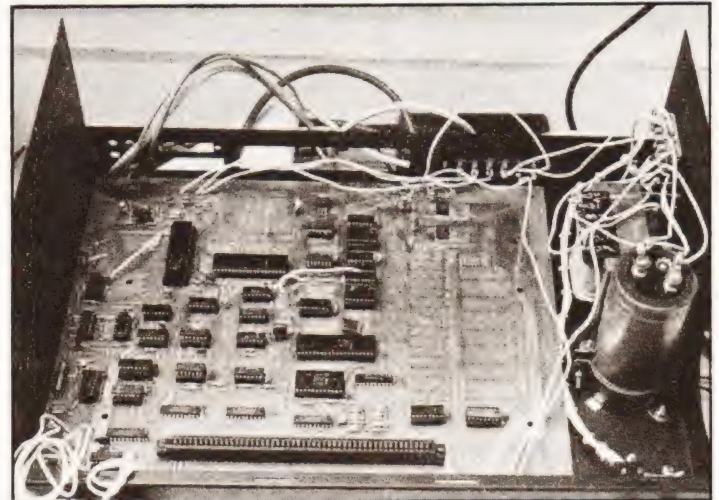
accounts of the language in CT and elsewhere I won't bore the devotees or antagonise the critics of this language by going through it all again. Suffice it to say that all the normal functions are included.

### Extras

No keyboard is supplied with the Explorer, neither does it have the capability to directly drive a display. This means that unless you've got the odd terminal kicking around doing nothing you and your Explorer are going to suffer severe communication problems. Fear not — Newtronics to the rescue! They sell a terminal (ASCII keyboard and video board) which could have been made for the job. The display can go to either a TV or monitor. The character font con-



Close-up of the main board showing the empty RAM and ROM area and the S100 expansion slot.



The main PCB cased with its power supply. Note the generous supply of socket holes on the back — good forward planning.

sists of the full ASCII character set plus Greek (yes Greek) alphabet. Cursor control is also available, just add a PSU and you've got all you need.

For those among us who consider video display frivolous and would rather produce pictures of scantily clad young ladies on a Teletype, the Explorer can help you too. Interfacing with a Teletype is simplicity itself and probably one of the cheapest ways to produce hard copy.

A case to house the Explorer and a power supply to run the full expansion is also available. There's even a cut out for a fan but I'm told the machine in the shop stays cool without one.

### Remarks

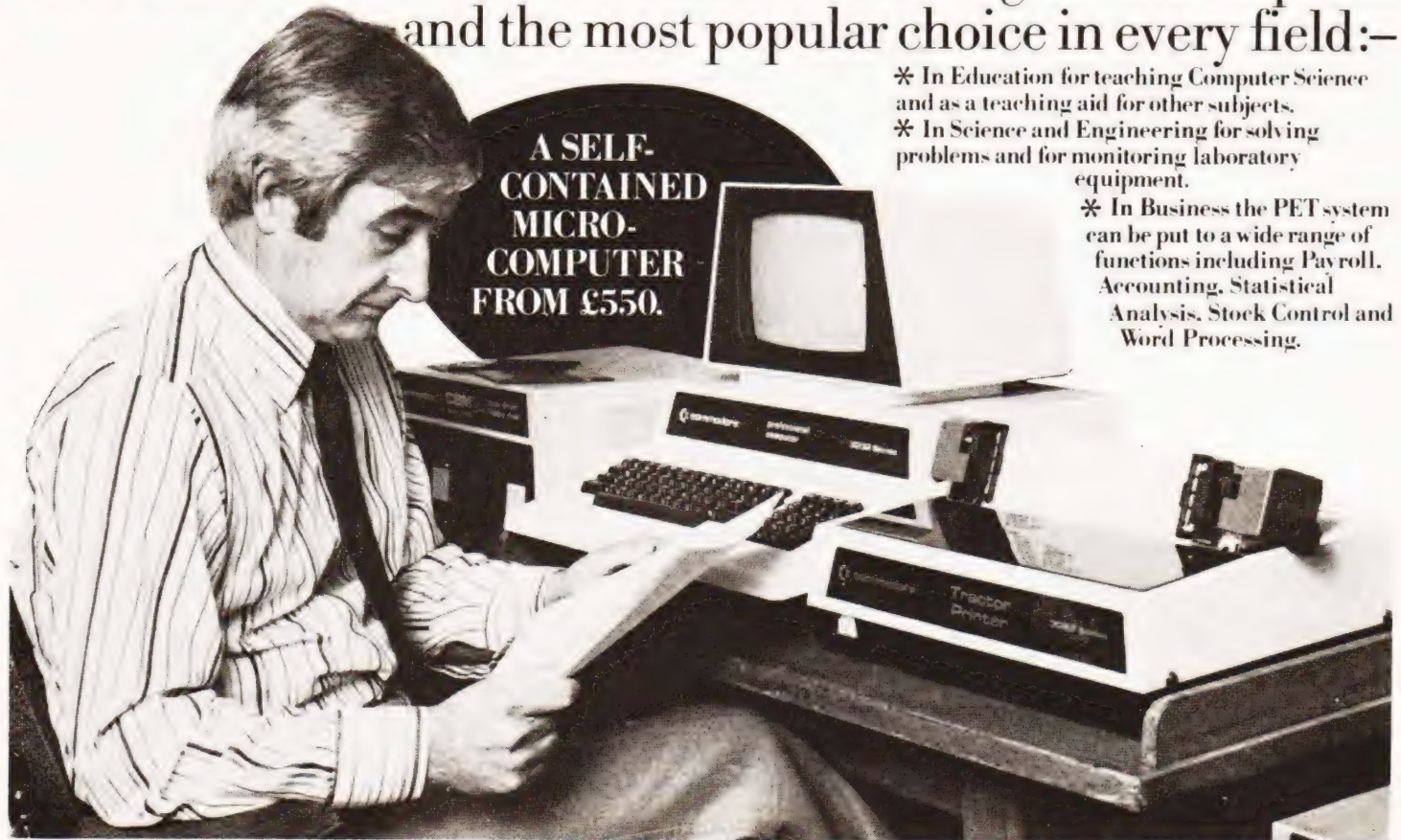
The Explorer is definitely a quality basis for a full system, as large as you need. Unfortunately, the price reflects this. With only levels A, B & D, a Newtronics terminal and a power supply, it sets you back around £500. Viewed in the context of a system being readily expandable (as this definitely is) the cost is not prohibitive but whether it represents value for money would very much depend on the individual's immediate application and future plans for the system.

### Acknowledgement

Thanks to HL Audio (Newtronics) for the loan of the machine and their help in preparing this report.

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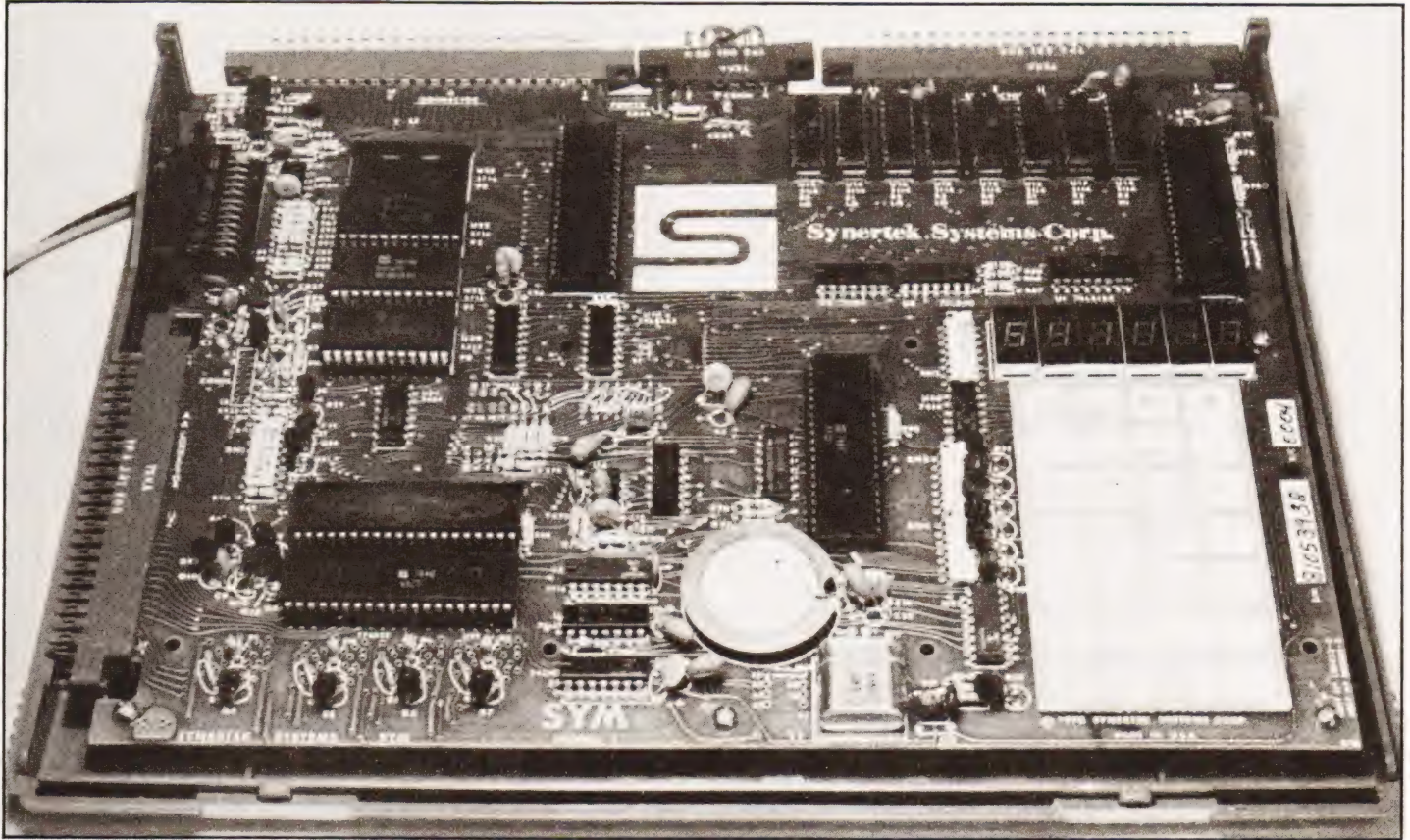
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# SAMSON REVIEWED

John FitzGerald



## Underneath a new exterior the Samson reveals itself as an original 'Mighty Micro.'

**W**hen the Editor slipped me a Samson-1 with a request to review it, I wondered what I was getting. It was a pleasant surprise to discover that the Samson is just a Sym-1 in a smart plastic case. I had played with a Sym for a few days some months before and was pleased to get my hands on one again. If you are thinking of spending your hard-earned cash on one of these space-age toys, you need to know one thing. Is it any good? I am happy to report that the Samson *is* good — very good.

### The Samson-1

For the technically minded, a functional block diagram of the system (Fig.1) shows the major hardware features of the Samson and indicates some of the many expansion options available. The computer is housed in a two-piece plastic case. The upper section is pivoted on two plastic studs making it "click-fit" and thus easily removable. A clear plastic cover may be slid down to cover the keyboard and display. I found it easier to remove the lid completely as even with the cover slid out of the way, access to the keyboard is severely limited; requiring an awkward vertical stabbing motion.

The Samson is supplied fully assembled with two comprehensive manuals and a programmer's reference card included. The only extras required are a 5 V 1.5A power supply, suitably protected against overload, and a cassette recorder for low-cost program and data storage.

A high quality, double sided printed circuit board holds all the components including a 28 key 'spongy-plastic'

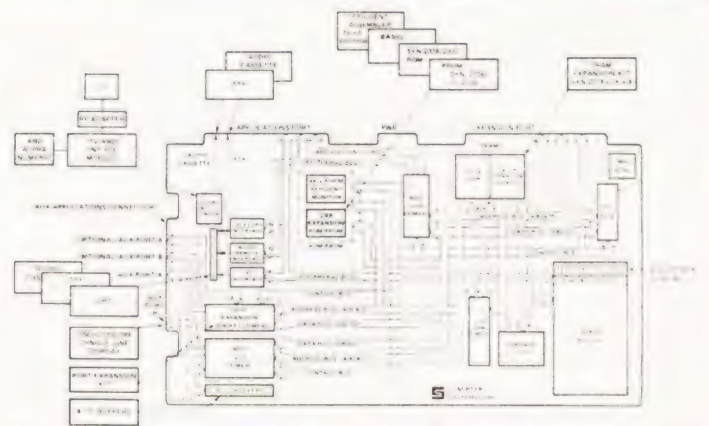


Fig.1. System architecture of the Samson/Sym. Enough to satisfy most single boarders.

keypad and a 6 digit 7 segment display. Also included is a piezo-electric 'bleeper' similar to those used in digital alarm watches. This gives an audible response each time a key is pressed making use of the keyboard a much more certain operation. Of course, it is all under software control and yes, you *can* play tunes on it! The 'debug' function is achieved with a hardware connection and this key does not give an audible response. However, the reference manual includes details for connecting a LED indicator which would easily remedy this omission. Though designated on the functional block diagram as a 'Hex' display, the on-board LED display consists of six standard seven-segment units resulting in the usual 'abbreviated' representation of the alphanumeric character set. The red display is nonetheless quite bright and easy to read. Use of a small piece of polaroid would make it even better. A red plastic filter was included with our unit.

Sockets are provided for the MOS integrated circuits. Make sure the chips are fully inserted before applying power.

A nice feature is the provision of blank sockets on the board enabling the memory to be expanded up to 4K and extra input-output to be fitted by simply plugging extra chips into the appropriate sockets. Extra RAM and a port expansion and connector kit are available as part of the Samson system. The overall layout of the printed circuit board is clean and uncluttered and component and connector positions are clearly marked on the component side in white ink.

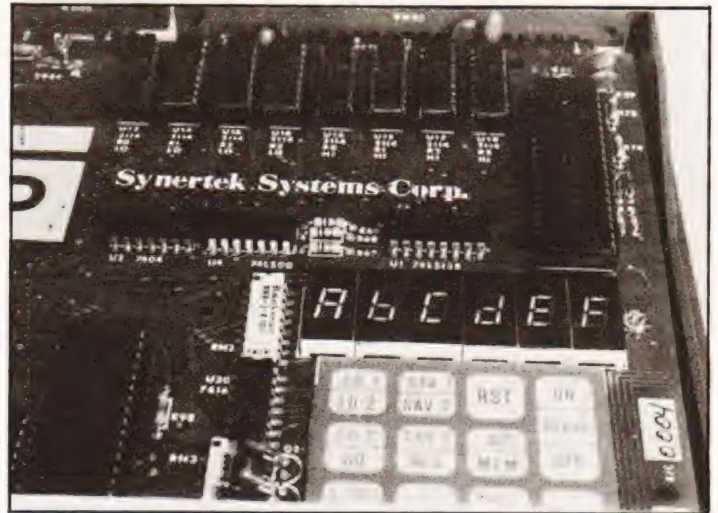
The documentation supplied with the Samson deserves a special mention. As well as a reference card containing op-codes, system addresses, etc, two manuals are supplied. One features all the information that you will ever need to know about the processor's instruction set while the other contains essential data for the hardware orientated enthusiast as well as complete data sheets on the major LSI chips. Both are produced on good quality white paper with a wealth of diagrams and useful hints. These are the kind of books that cost you a fiver each in the shops and they come as standard issue with the Samson computer.



Fig.2. The Sym/Samson keyboard layout.

### Chips

The heart of the system is a 6502 microprocessor running at a 1MHz clock frequency. This will be familiar to computer buffs as the 6800 derived powerhouse used in the KIM, PET, Apple, Acorn and Tangerine systems. (I wonder why hard-headed manufacturers choose such fruity names!) There are two 6522 Versatile Interface Adaptors in the basic system which handle input-output. These also contain software programmable timers which can be configured in numerous ways. In short, as their name suggests, they are versatile – very! Provision is made on board for insertion of a third 6522 if you can think of a use for it that is not already provided for. The board fairly bristles with connectors. These are high quality double sided, gold plated pads and mating sockets are provided either with the basic unit or are available as part of an expansion kit. Also present is a 6532, RAM, I/O, timer array which offers many features comparable to those offered by the 6522. What makes the 6532 special is the inclusion on-chip of 128 bytes of random access memory. This is software write-protectable and is used by the monitor to store system vectors and as scratch-pad memory.



B The alpha characters supported by the Samson display.

### Memory

As well as the RAM contained in the 6532, 1K of RAM is provided in the basic system in the form of two 2114 (1024 x 4) chips. One 4K ROM chip holds the 'Supermon' monitor and there are spare sockets for an 8K BASIC interpreter and a resident assembler-editor. Pairs of 2114 chips are available as the 'Samson Static RAM memory' enabling expansion of the on-board RAM in 1K blocks up to 4K.

### Monitor

The 'Supermon' monitor is the largest I have come across in a single board computer . . . and it does not stop there. Expansion is possible through the use of eight undefined keys (USR 0 thru' USR7). These normally return control to the monitor via a vector address written into system RAM. By changing this address to point to a user written routine you can expand the facilities offered by the monitor in any desired way. Excellent and extensive hardware is provided on the Samson board and this is well used by the monitor which supports the following input-output and storage media :-

TTY – selectable current loop

VDU – RS232 interface. Baud rate is automatically determined by the monitor at log on.

Paper tape – data is stored as pairs of ASCII characters.

Audio cassette – two formats are available. The low speed system is KIM compatible and operates at 8 bytes/sec. A high speed mode is also provided and runs at 185 bytes/sec. A simple program is included in the reference manual enabling the generation and use of SYNC tapes facilitating adjustment of the cassette recorder. One with both volume and tone controls is recommended.

Oscilloscope display – this enables a single line of text containing up to 32 characters to be displayed on a conventional 'scope which is all you need to supply. A suitable software driver is included in the reference manual and instructions are given for generating your own character set.

The extensive use of command vectors enables the Samson owner to direct input-output to any chosen device(s). Some examples of how to do this are given in the manual which also contains a complete and legible listing of the monitor.



# SAMSON REVIEWED



F  
A typical screen dump showing the squashed display. The Hex pair on the right is the checksum.

This facilitates the use of monitor routines in your own programs and is an aid to anyone learning to use machine code. Table 1 shows the monitor commands and their function.

## KIM Compatibility

The Samson is designed to be generally upwards compatible with MOS-Technology's single board KIM computer. In

Command	Function
M	display-modify memory
R	display-modify user registers
G	restore user registers, resume execution from PC
V	display 8 bytes of data with their checksum
D	deposit data from keyboard to memory
C	calculate using Hex arithmetic, displacements etc.
B	block move in memory
J	jump (0-7) loads PC with address from system RAM
SD	stores a double byte
F	fills block of memory with chosen byte
W	write protect user RAM in 1K blocks
E	adjusts monitor to receive input from RAM
S1	save cassette tape KIM format
S2	save cassette tape high-speed
L1	load KIM format tape
L2	load high-speed tape
SP	save paper tape
LP	load paper tape
CR	carriage return
+	advance 8 bytes
-	retreat 8 bytes also used as delimiter
→	advance one byte or register
←	retreat one byte
USR0-7	user defined keys
SHIFT	select upper case
RST	reset
DEBUG	hardware debug function
ON-OFF	
ASCII	next two keystrokes combined to form one ASCII character.

Table 1. The Supermon command set.

practice this means that some of the connectors are different; for example, the Samson uses a separate connector for the power supply, and some of the signals are absent or renamed. Though both machines use the same microprocessor, the 6502, they are not directly software compatible. Inconsistencies include timer addresses and a number of monitor routines. Those most likely to concern the prospective user are the keyboard and monitor sections which feature most strongly in pre-written KIM software; for example, in the 'First Book of KIM'. It is possible to use programs from this source. However, you will have to provide some software links to the Samson system. These are best provided in the form of subroutines which can be called when required. Here's a tip. Remember that you must call 'ACCESS' before you can even begin to think of getting at the LED display.

## BASIC

For anyone who turns white and shivers at the first mention of machine code, those nice people at Samson (Synertek — why pretend?) have come up with an 8K BASIC Interpreter. Supplied in the form of two 4K ROMs, it only requires plugging in to the sockets provided and a couple of wire jumper changes to be up and running.

With BASIC installed, following power-on, a TTY is logged on from the Hex keyboard or a VDU is logged on by typing 'Q'. The monitor responds with a prompt '.'. Now if J 0 (CR) is entered, BASIC responds by asking for the memory size to be used. Any value greater than 512 bytes may be entered. BASIC will use all contiguous memory from location 0200 (Hex) to the value specified. This enables space to be reserved for machine code routines. You will then be asked to specify terminal width which determines the output line width for PRINT statements only. There is a default value of 72 characters though any value between 1 and 255 may be used. BASIC will then type out the number of free bytes, Synertek's banner and 'OK'. The prompt character (.) is replaced by a flashing cursor if you are using the Samson terminal.

There is no space here for a full description of the BASIC. It seems to have everything you would expect from an 8K interpreter and includes commands enabling you to use machine code routines in your programs. A sixty-page manual contains a brief history of BASIC with notes on its implementation in the Samson system and some worked examples and details of common pitfalls. There is certainly nothing wrong with the BASIC provided and it is good to see it offered as part of what looks at first glance like a simple development kit. However, I cannot help feeling that, if you want to talk BASIC, you should just go out; buy a PET, put the Programmer's Toolkit on it and talk to that. PET speak heap good BASIC! . . . and the screen editing and graphics capabilities are excellent for a black and white system. The Samson is a superb piece of hardware with excellent software support and it seems foolish to ignore all that just to talk pidgin English!

## Samson In Orbit

The Samson Satellite consists of yet another Synertek product, the KTM-2, in another plastic case. This is a full-size keyboard mounted on a single PCB which also contains circuitry to drive a display monitor. There are two models differing primarily in the number of displayed characters per line. The 40 character version may be used with an ordinary television while the 80 character unit requires a video monitor. An RF modulator is not supplied with either unit and must be purchased separately. Power requirements are simply 5 V at about 1 amp.

# SAMSON REVIEWED

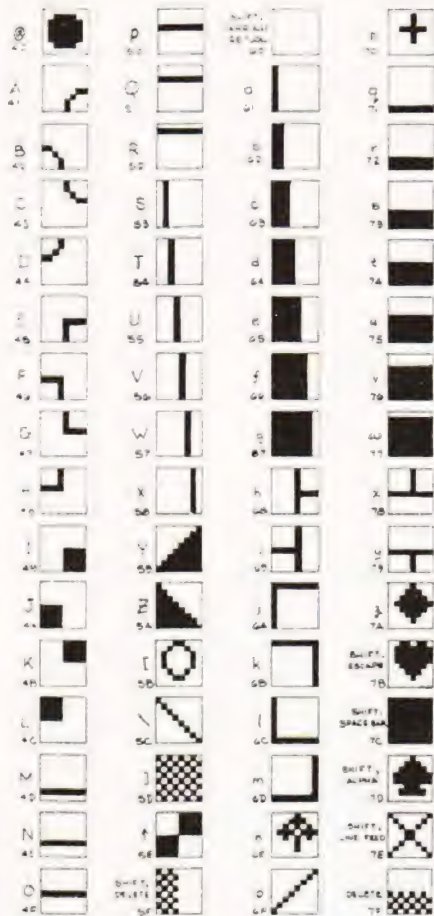


Fig.3. The graphics set of the Satellite terminal.

The keyboard consists of 54 keys which enable the full ASCII set and 128 graphics characters to be generated. Graphics and alpha-numerics may be displayed simultaneously and the cursor may be software driven using absolute or relative addressing. There are two full-duplex serial communication ports enabling the Satellite to interface to a computer and printer simultaneously. Transmission rate is adjustable between 110 and 9600 baud. There are eight ranges selected by three switches. Other switch selectable functions include :

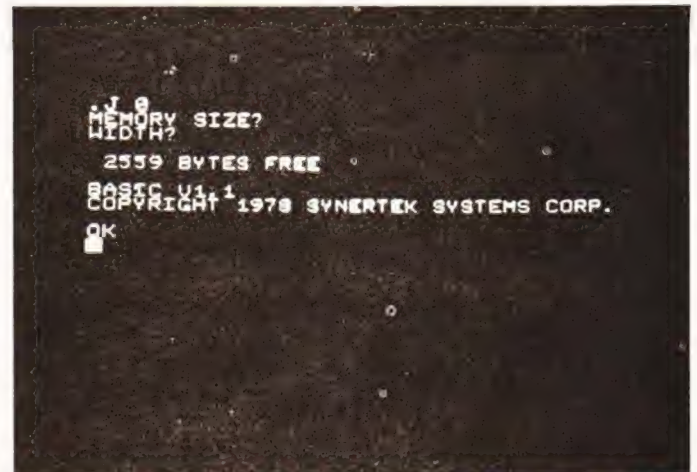
- even, odd or no parity
- interlaced or non-interlaced display (an interlaced display may appear to flicker on a screen with a short persistence phosphor.)
- line truncate or wraparound and
- choice of 50Hz or 60Hz frame rate.

Almost everything in the Satellite responds to automatic control. The cursor may be moved, screen cleared, graphics selected or de-selected and reverse video turned on or off : all under software control. You enable the auxiliary communications port with an ASCII control code too!

As you will see from our photos, the Satellite's character rows are very close. This was done primarily for the graphics characters to connect in a vertical direction but does result in a rather cramped display with an awkward aspect ratio. One or two extra scan lines may be added by re-configuring some jumpers on the PCB. Full details are given in the 40 page A4 size manual which includes all the technical data required and adds some hints for users operating Synertek BASIC.



D How characters are made up on an oscilloscope display.



E What you get when you jump to BASIC.

	100	20	88	81	JSR SAVER
	103	A9	0D		LDA 0D
	105	20	A5	89	JSR CONFIG
LOOP	108	A9	08		LDA 8
	10A	8D	02	A4	STA PBDA
	10D	20	1B	01	JSR
	110	A9	06		LDA 6
	112	8D	02	A4	STA PBDA
	115	20	1B	01	JSR
	118	4C	08	01	JMP LOOP
	11B	A0	50		LDY 50
	11D	88			DEY
	11E	D0	FD		BNE FD
	120	60			RTS

Program to make the bleeper bleep, alter value at 011C to change note pitch.

The Satellite is a well produced unit offering many sophisticated features and makes a good companion to the Samson-1. In conclusion, the Synertek BASIC and Satellite terminal are good. The Samson (Sym-1) is very good indeed and deserves to find wide acceptance in this country. If this article has whetted your appetite, all you have to do now is come up with the cash, go out and get one!

# Happy Memories

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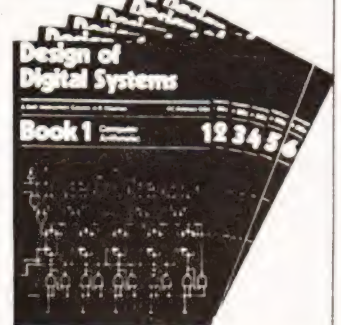
**Book 2** High and low level languages; flowcharting, functions, REM and documentation: INPUT, IF, THEN, GO TO, limitations of computers, problem definition

**Book 3** Compilers and interpreters, loops, FOR...NEXT, RESTORE, debugging, arrays, bubble sorting, TAB

**Book 4** Advanced BASIC, subroutines, string variables, files, complex programming, examples, glossary

## Understand Digital Electronics

Written for the student or enthusiast, this course is packed with information, diagrams and questions designed to lead you step-by-step through number systems and Boolean algebra to memories, counters and simple arithmetic circuits and finally to an understanding of the design and operation of calculators and computers.



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**Book 5** Structure of calculators; keyboard encoding; decoding display data; register systems; control unit; program ROM; address decoding

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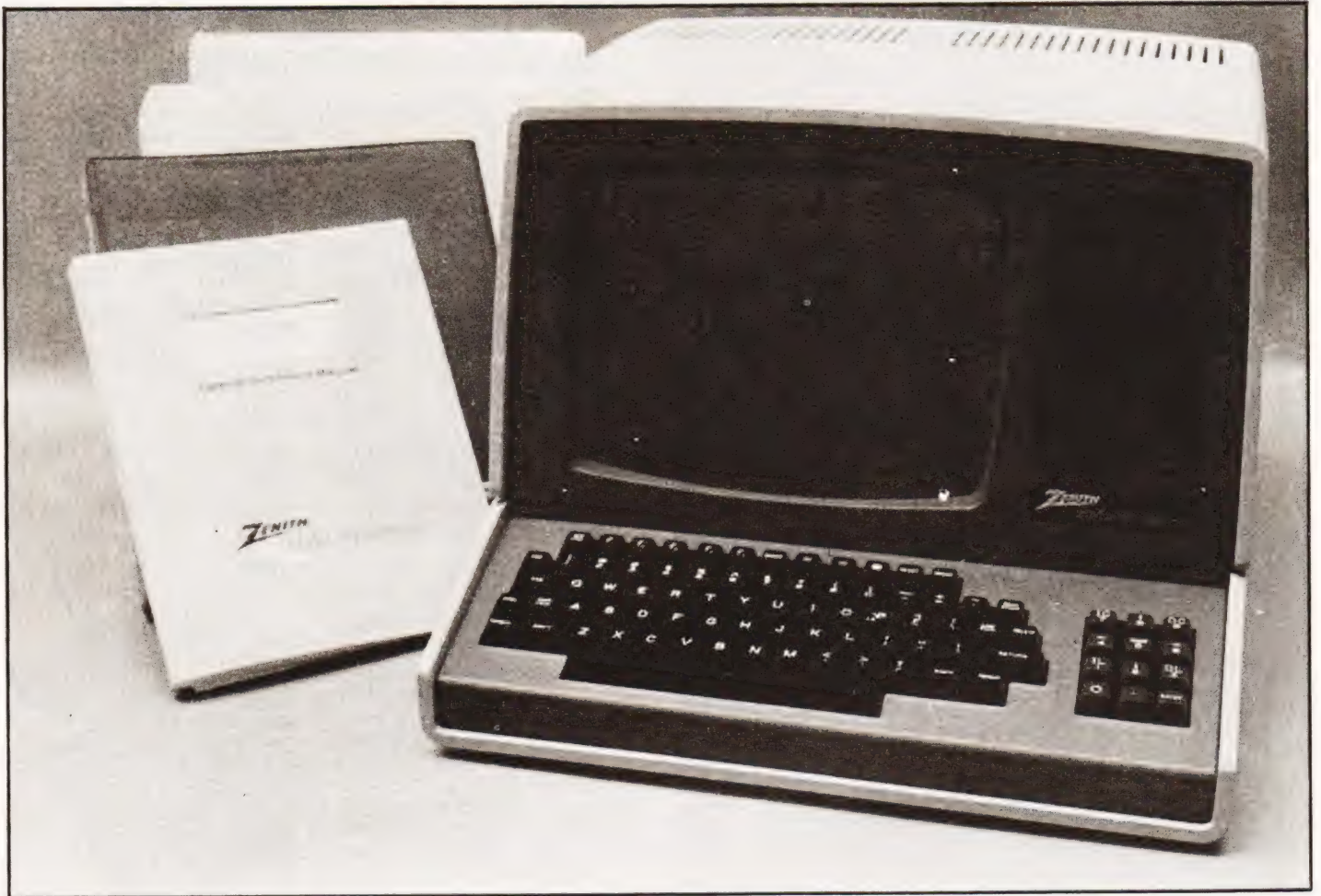
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## Heathkit's entry into the world of small systems could represent a breakthrough in affordable computing.

**T**he Zenith Z89 is a dual-processor system based upon the Z80 CPU chip. In effect it is two machines in one box. The VDU has its own controller, totally independent of the main CPU. Standard memory configuration is 48K of user RAM with 8K of system RAM and ROM. The keyboard is a fairly standard QWERTY affair, with a 12 key numeric pad also adorning the front panel. The VDU has . . . look — hold it here a minute. This machine has more facilities than I've had hot dinners and if I go on listing and describing we're all gonna be here until the sun goes cold and England win the World Cup again.

Table One is a summary of the hardware features of the system and after you've glanced down it I'll go over some of the more interesting abilities possessed by the unit.

### Any Port In A . . . ?

There now. That didn't take long. One thing not mentioned are the output ports to allow for the hanging on of peripherals. These are RS232 standard with a data rate of between

110 and 9600 bps, user specified. Parity can be odd, even, or anything else you can dream up, it is flexible.

The system as a whole is exactly that — flexible. The machine makes use of its size to offer the user a flexibility and potential undreamed of — and undreamable — in the lower priced computer systems.

At this price, which could be described, at present, as lying above the high priced home machines, the Sorcerors and the rest and yet below the lowest end of committed business systems, who can be expected to seek out and purloin a Z89? Well, anyone needing a very versatile and powerful computing tool, with an excellent built-in disc facility and great 'keyboard' power would be advised to look here. The Z89 can be an absolute top-class home system, or a very useful business machine for the smaller company, take your pick.

It seems to fulfil what many of the earlier machines promised — but fell short of. It is truly a complete, yet expandable, computing system. It arrives with built-in disc

# ZENITH Z89 REVIEWED

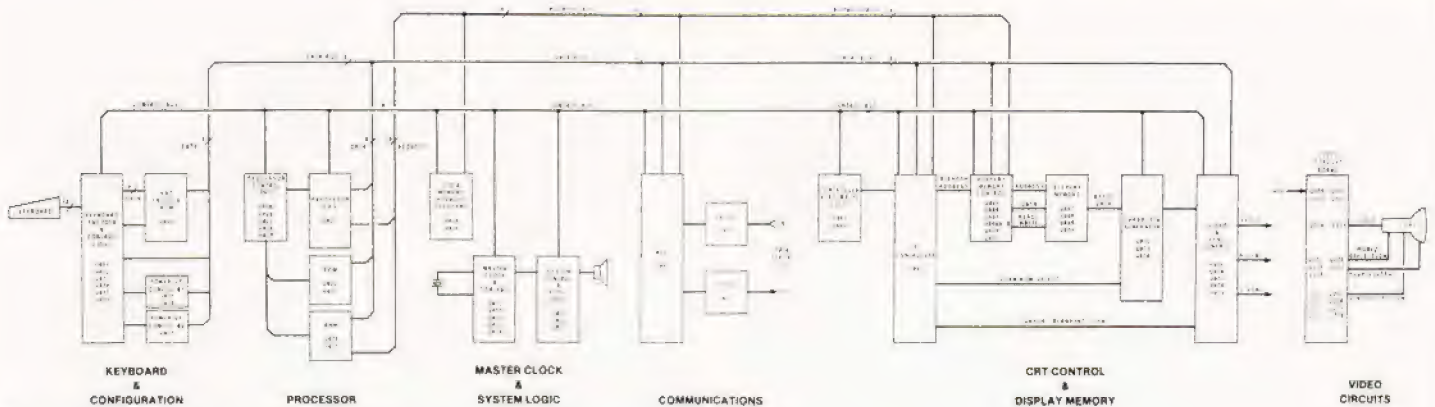


Fig.1. And this is just a system diagram!

drive and facility for adding on an external Z87 dual disc. Each 'diskette' has 100K of storage and is of 'hard sector' type, which means that the size of each sector is hardware determined by the PCB, not by the software controller. This in-turn means that the sector size is fixed. Sectors are allocated to files in 'increments' of two '256-bytes' as required by the operating system.

## What Comes With . . .

Heathkit supplied us with all the manuals you ever dreamed of, including the one for the WH 89 — the kit version of the Z89. Mind you, kit is a misnomer really, as most of the PCBs arrive assembled! Module assembly would be a better term. As usual for Heathkit, the documentation is faultless, if a little daunting in this case. We got a huge binder for CPM, one for HDOS, another *two* for BASIC and a three inch thick WH 89 manual with circuit diagrams. The latter are complete down to component level, with full overlay documentation.

Well, I'll believe they've thought of everything — lest ten more manuals drop through my desk. You know, with all this paperwork — most of which contains a "What to do first" section, couldn't they add just one more little bit? A small, totally separate, approachable little pamphlet for each configuration, telling you how to get it up and DOING something, as opposed to sitting there humming gently and looking smart. On behalf of all the people who will buy this machine, take it home, put the plug on, switch on get "H:" on the screen — and get that empty "Oh God what now?" feeling in the pit of the stomach, PLEASE Heathkit?

Still, back-up looks like being very good and I doubt if even the most obnoxious purchaser would find himself turfed out in the street, box in one hand and manuals in the other.

Heathkit were very helpful indeed to us — even putting HDOS onto each of the discs they loaned us to save messing about having to keep shuffling the source discs.

## Soft Touch

After experimenting with both the CPM and HDOS we were provided with, I developed a preference for HDOS to the extent that CPM stayed in its folder after the first couple of runs, unbidden while HDOS spun its triumphant way across the heads.

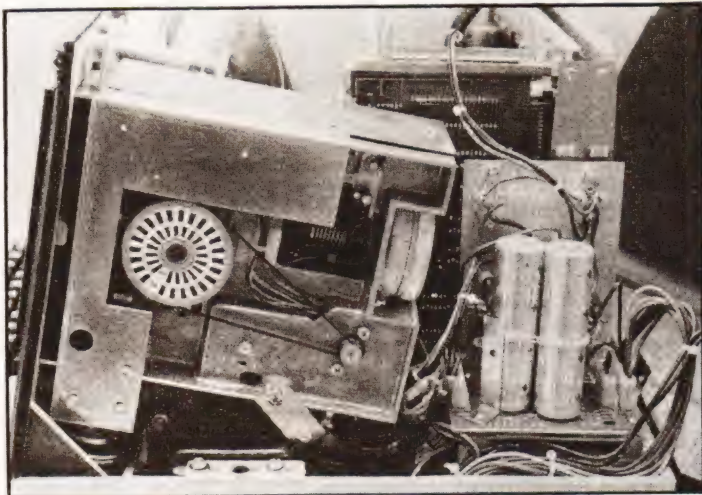
Somehow HDOS is simply more usable and flexible — it lets you get at the material it is handling with the minimum of interference and the maximum facility. The perfect librarian, in fact — and what else can you ask from a disc operating system?

<b>Processor:</b>	Z80
<b>Clock:</b>	2.048 MHz
<b>Memory:</b>	48K bytes RAM. 8K for systems ROM and RAM. 8K reserved.
<b>CRT:</b>	12" diagonal, P4 phosphor.
<b>Display Format:</b>	24 lines of 80 characters, plus 25th user-status line.
<b>Display Size:</b>	6.5" high x 8.5" wide.
<b>Character Size:</b>	0.2" high x 0.1" wide (approximate).
<b>Character Set:</b>	128 (95 ANSI, plus 33 graphics).
<b>Character Type:</b>	5 x 7 dot matrix (Upper case); 5 x 9 dot matrix (lower case with descenders).
<b>Keyboard:</b>	72 keys (60 alpha-numeric, 12 function control) plus a 12-key numeric pad.
<b>Cursor:</b>	Blinking or reverse video block or off.
<b>Cursor Controls:</b>	Up, down, left, right, home, CR, LF, back space, and tab, from keyboard or computer.
<b>Cursor Addressing:</b>	Relative and direct.
<b>Tab:</b>	Standard 8-column tab.
<b>Refresh Rate:</b>	60 Hz at 60 Hz, 50 Hz at 50 Hz line frequency.
<b>Edit Functions:</b>	Insert and delete character or line.
<b>Erase Functions:</b>	Erase line, from beginning of line to end of line; erase page, from beginning of page, to end of page.
<b>Bell:</b>	Audible alarm on receipt of ASCII BEL.
<b>Video:</b>	Normal and reverse by character.

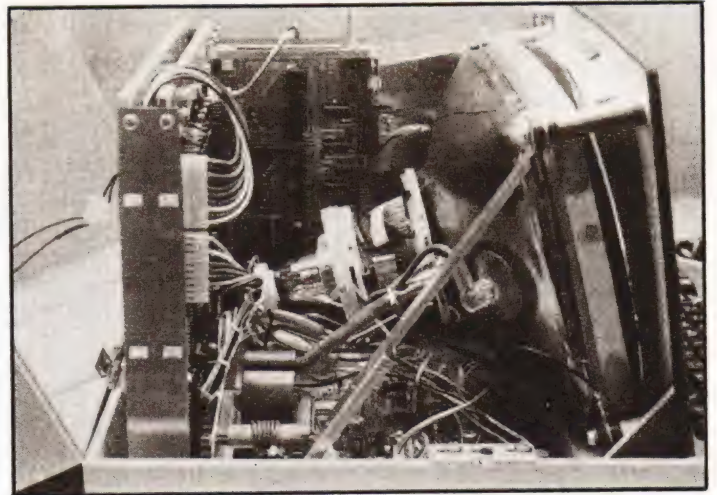
Table 1. All these features add up to an awful lot of power and flexibility.

The folder for HDOS is very well written and produced and the opening chapters nicely sectioned with "First time through" lists every now and then to help a new convert learn his art. That little pamphlet I wanted could be no more than these sections extracted and re-presented. As it is, if you don't know where to look you'll never find it!

My advice to any new or aspiring owner of a Z89 is to sit down, with a cup of tea and the HDOS manual and READ IT. It is approachable and conversational in style and easy to digest, managing to avoid the usual half incomprehensible flood of abbreviations and jargon that swamps some rival efforts. A new user needs to be told what he has obtained for his money, not shown what a clever little boy the manual



The hard sectored disk can be backed up by two external brothers.



All neatly packed in with acres of room to service.

000000A to 007377A	MTR-88 ROM (2K)
010000A to 023377A	UNUSED (3K)
024000A to 027377A	HDOS RAM WORK AREA (1K)
030000A to 037377A	HDOS ROM (2K)
040000A to 041147A	SYSTEM RAM AREA (360 bytes)
041150A to 042177A	USER STACK AREA (280 bytes)
042200A to SYSFWA-1	USER PROGRAM AREA
SYSFWA to LAST RAM ADDRESS	RESIDENT HDOS SYSTEM (approximately 2K)

Fig.2. Schematic of the elephant's brain!

author can be. Heathkit could hold classes for the opposition on producing manuals — if any of them would bother to go, that is.

### Side One, Track One

Supplied with the Z89 is a 'distribution diskette' as they call it, containing the operating system, HDOS, with a few very useful little ditties, like BASIC, DBUG, EDIT and ASM. I'm afraid that in the space I have in this magazine I can do little but whet your appetite as to the scope of these files. Suffice it to say :

**BASIC** :— an extended 16K BASIC with all that implies. This is the 'Benton Harbour BASIC'. Microsoft BASIC 80 is also available, but requires 28K of RAM, and thus will run best on the minimum of a 32K system. No problem with a Z89. This includes line renumbering, amongst other things, and sufficient facilities to make any BASIC nut offer up an arm or two.

**DEBUG** :— makes use of HDOS to allow for full debugging of machine-code programs. Will display and alter the contents of any specified memory location, or 8080 compatible register; will execute a program either completely, or line by line; will load or dump programs onto discs, printers VDUs etc; and will insert 'breakpoints' executing several instructions then halting with control returned to DEBUG.

**EDIT** :— the Heath Text Editor. Will do nicely as a word processor, providing good editing facilities with 15 editing commands. You could write the annual report on this — or a note home to granny asking how the budgie is doing. Works very well too for editing BASIC programs.

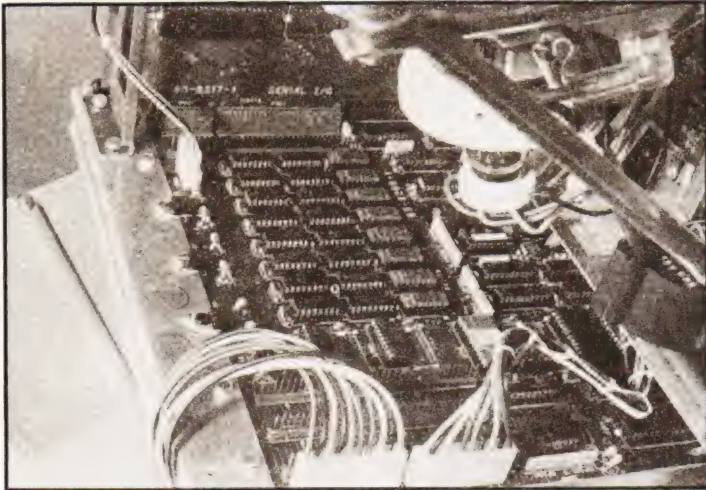
**ASM** :— Heath Assembly Language Program. Once you've got used to the EDIT you can use ASM to run source programs on the Z89. For best use you will have to know the 8080 pretty well.

As I said before there is much much more to these titles than I could get into a single issue. All I can do is recommend the supplied software very highly. It is well thought out and nicely tailored to the system. Useful and useable.

### Hard Times

With the hardware configured as two interactive portions we have a potentially very powerful beast and a potentially confusing one. The key to the whole operation is a little key tucked at the top left of the keyboard. Called OFF LINE, it means exactly that. Press this down and you disconnect the computer from the keyboard and screen (Fig. 3 ). This means of course that you can go on typing until your fingers drop off but the computer is totally ignoring you.

# ZENITH WH89 REVIEWED



One of the two main circuit boards with its daughters.

The advantages are great. The cursor can be shifted around, lines cleared — even screens cleared — without code transmission and hence the program knowing about it. Of course if you forget to put it back on-line . . . . .

There are eight user definable keys strung along the top of the board, which you yourself can set up to be something worth using — instructions are of course provided to do this.

Having an intelligent keyboard takes some getting used to after more basic systems, but it is a luxury you soon learn to live with, I promise you!

## First Blows

It might be illuminating to go through how you get the Z89 to run a program from scratch. Let's chose BASIC as an example, assuming that your distribution disc supplied with the machine contains Microsoft BASIC (MBASIC).

At switch-on "H:" appears in the top left of the screen and nothing else. You place your disc into the drive — getting it the RIGHT way around and type "B". The screen turns this into "BOOT" and a RETURN will bring you a "TYPE SPACES TO DETERMINE BAUD RATE". You now have to hit the space bar repeatedly for a few sections so that the system can pick up the speed at which your terminal operates. Then "ACTION? < BOOT >"

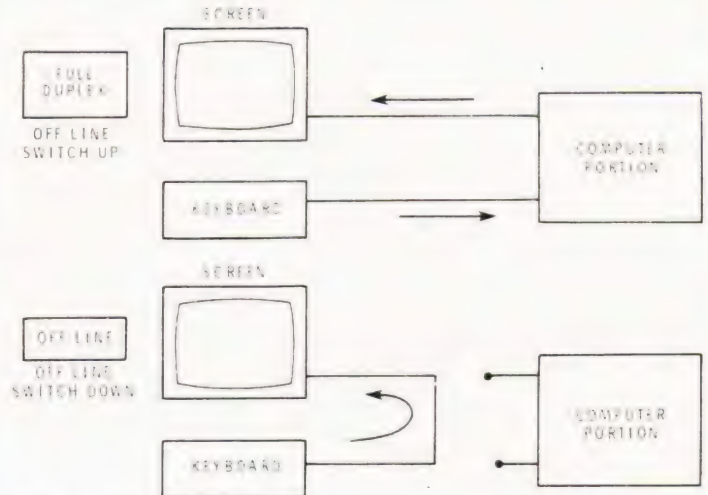


Fig.3. A trap for the unwary.

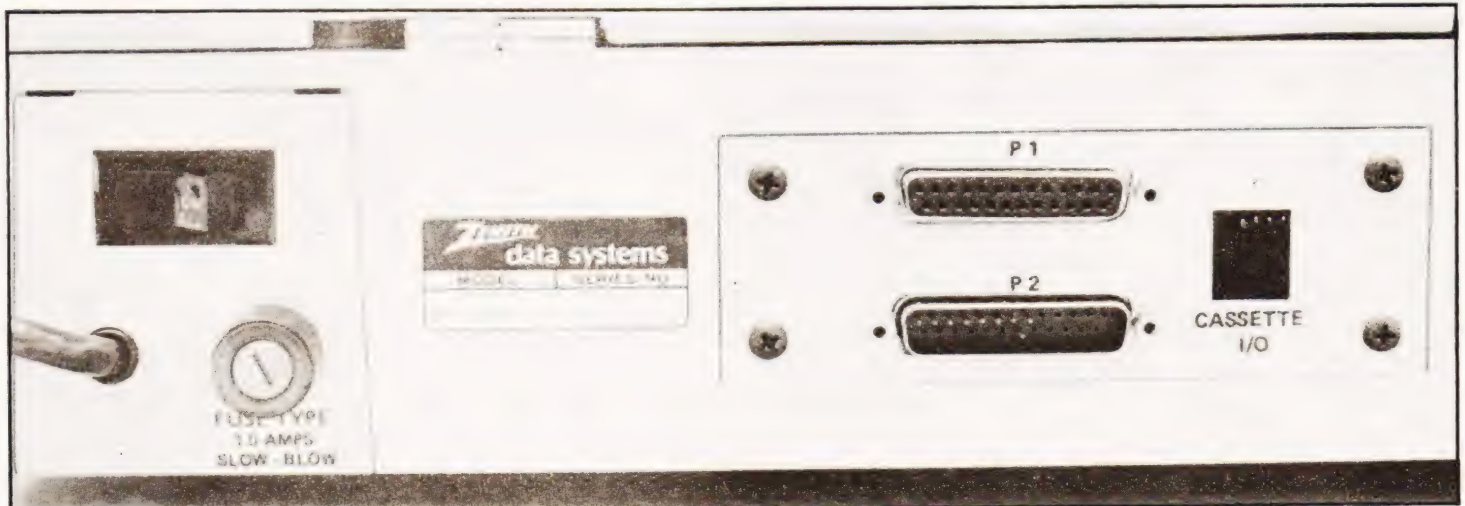
appears and a RETURN gets you "DATE [DD—MMM—YY]?" This is simply so the system can preface all your files with the origination date. Type it in and RETURN. A ">" now appears and you have loaded HDOS.

HDOS contains a test and a diagnostic routine, but we're after BASIC, so all we have to do now is type in the file name, MBASIC and wait until the clicking and flashing from the drive ceases. The screen will display the header for Microsoft BASIC, telling you which issue it is and how much RAM you've got left to play with. If you're a small systems man, being told that 21K remains free will probably induce feelings of inadequacy. Fear not. It is all under *your* control . . . . (isn't it?)

## Summary

Impossible to do. Summarising a machine only slightly less complex than the Secret Of Life is too much for me to cope with. My own impression of the Z89 is that it is a well designed, flexible, well supported computer that knocks the opposition sideways. It would be equally at home on a dining-room table or an office desk and should be examined very carefully if you have this amount to spend on a system. It is worth the extra for its flexibility and power.

I wonder if Heathkit would accept a slightly used soul as down payment . . . . .?



Expansion possibilities revealed.

# Britain's first comp

**A complete personal computer for a third of the price of a bare board.**

**Also available ready assembled for £99<sup>95</sup>**

## The Sinclair ZX80.

Until now, building your own computer could easily cost around £300 – and still leave you with only a bare board for your trouble.

The Sinclair ZX80 changes all that. For just £79.95 you get *everything* you need to build a personal computer at home... PCB, with IC sockets for all ICs; case; leads for direct connection to your own cassette recorder and black and white or colour television; everything!

And yet the ZX80 really is a complete, powerful, full-facility computer, matching or surpassing other personal computers on the market at several times the price. The ZX80 is programmed in BASIC, and you could use it to do quite literally anything from playing chess to running a power station.

The ZX80 is pleasantly straightforward to assemble, using a fine-tipped soldering iron. Once assembled, it immediately proves what a good job you've done. Connect it to your TV set... link it to an appropriate power source\*... and you're ready to go.

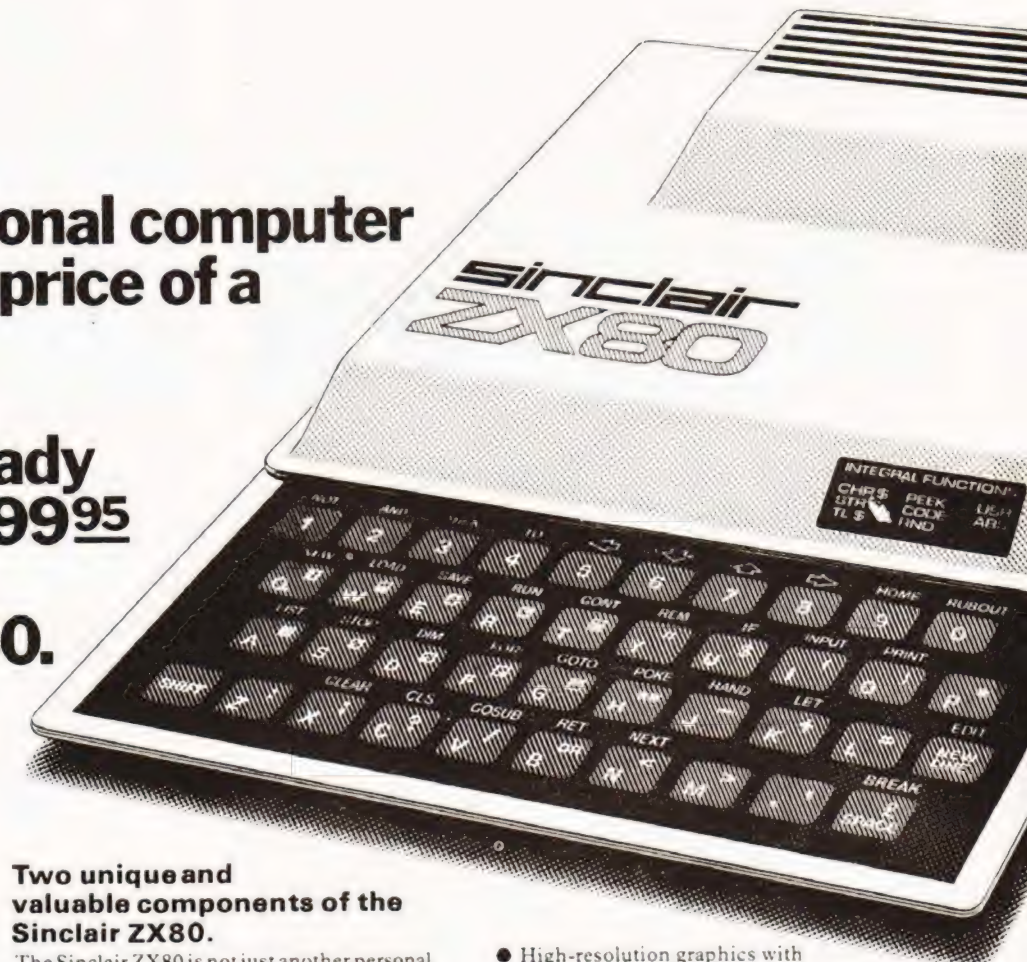
### Your ZX80 kit contains...

- Printed circuit board, with IC sockets for all ICs.
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- FREE course in BASIC programming and user manual.

### Optional extras

- Mains adaptor of 600 mA at 9 V DC nominal unregulated (available separately – see coupon).
- Additional memory expansion boards allowing up to 16K bytes RAM. (Extra RAM chips also available – see coupon).

\*Use a 600 mA at 9 V DC nominal unregulated mains adaptor. Available from Sinclair if desired – see coupon



### Two unique and valuable components of the Sinclair ZX80.

The Sinclair ZX80 is not just another personal computer. Quite apart from its exceptionally low price, the ZX80 has two uniquely advanced components: the Sinclair BASIC interpreter; and the Sinclair teach-yourself BASIC manual.

The unique Sinclair BASIC interpreter... offers remarkable programming advantages:

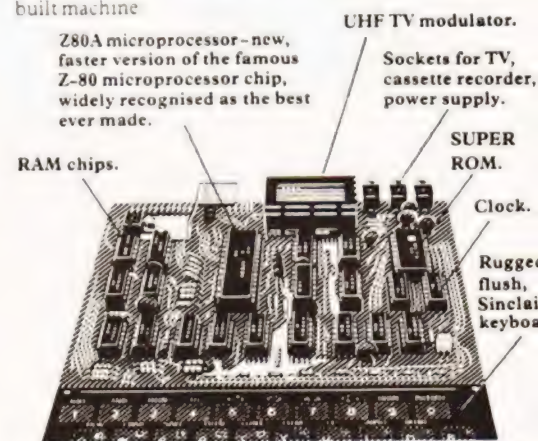
- Unique 'one-touch' key word entry: the ZX80 eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.
- Unique syntax check. Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately. This prevents entry of long and complicated programs with faults only discovered when you try to run them.
- Excellent string-handling capability – takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The ZX80 also has string input-to-request a line of text when necessary. Strings do *not* need to be dimensioned.
- Up to 26 single dimension arrays.
- FOR/NEXT loops nested up to 26
- Variable names of any length.
- BASIC language also handles full Boolean arithmetic, conditional expressions, etc.
- Exceptionally powerful edit facilities, allows modification of existing program lines.
- Randomise function, useful for games and secret codes, as well as more serious applications.
- Timer under program control.
- PEEK and POKE enable entry of machine code instructions, USR causes jump to a user's machine language sub-routine.

- High-resolution graphics with 22 standard graphic symbols.
- All characters printable in reverse under program control.
- Lines of unlimited length

... and the Sinclair teach-yourself BASIC manual.

If the features of the Sinclair interpreter listed alongside mean little to you – don't worry. They're all explained in the specially-written 128-page book *free* with every kit! The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming – from first principles to complex programs. Available separately – purchase price refunded if you buy a ZX80 later.

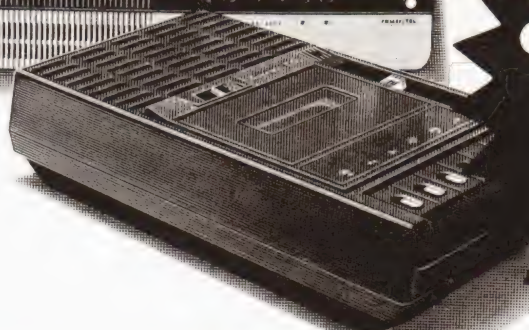
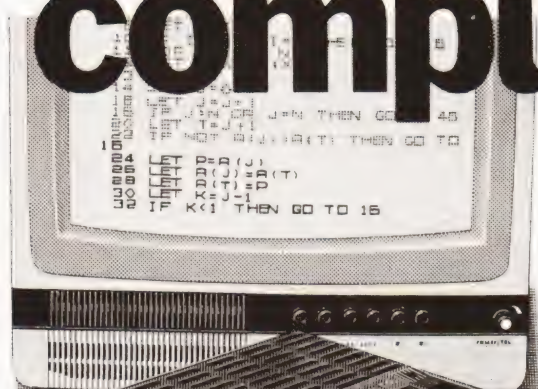
A hardware manual is also included with every kit or built machine



COMPUTING TODAY JUNE 1980



# Complete computer kit.



**£79<sup>95</sup>**  
 Including VAT.  
 Including post and packing.  
 Including all leads and components.



**Fewer chips, compact design, volume production – more power per pound!**

The ZX80 owes its remarkable low price to its remarkable design: the whole system is packed on to fewer, newer, more powerful and advanced LSI chips. A single SUPER ROM, for instance, contains the BASIC interpreter, the character set, operating system, and monitor. And the ZX80's 1K byte RAM is roughly equivalent to 4K bytes in a conventional computer – typically storing 100 lines of BASIC. Key words occupy only a single byte.

The display shows 32 characters by 24 lines. And Benchmark tests show that the ZX80 is faster than all other personal computers.

No other personal computer offers this unique combination of high capability and low price.

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	Sinclair ZX80 Manual(s) (manual free with every ZX80 kit or ready-made computer).	5.00	
		<b>TOTAL</b>	£

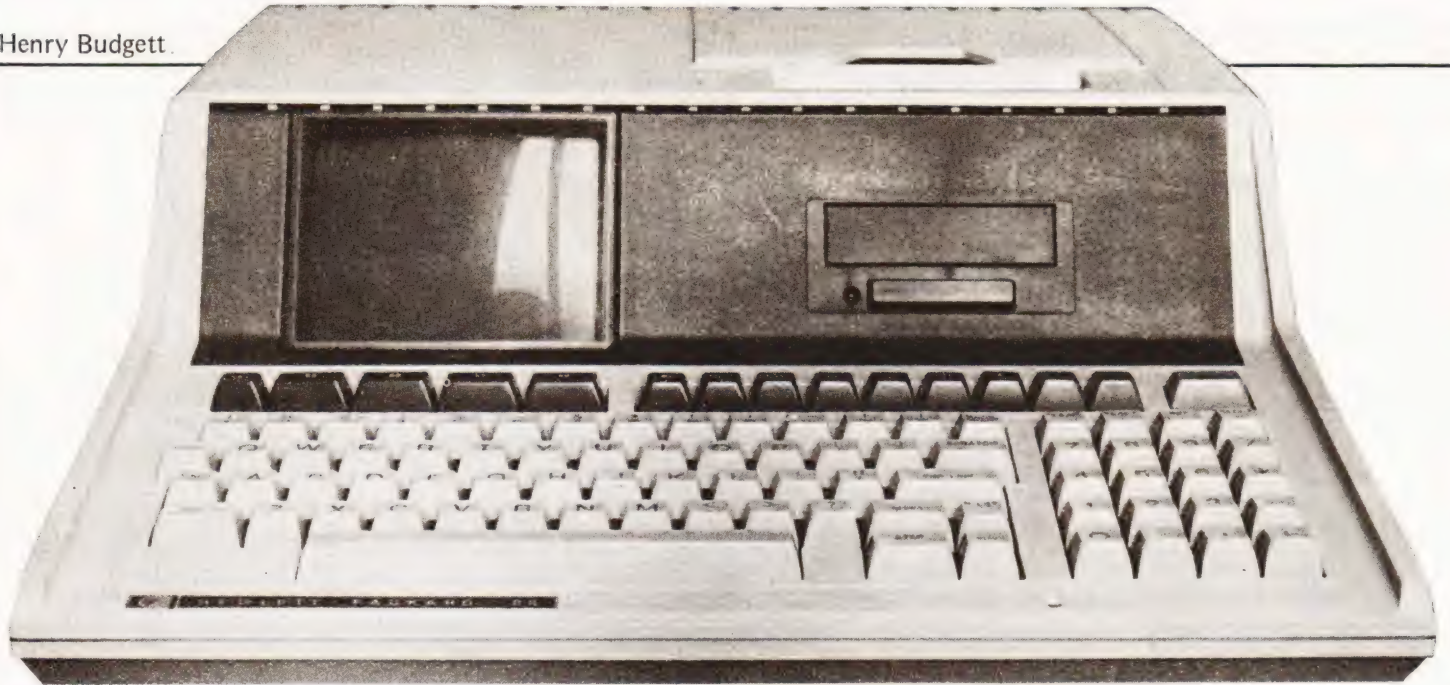
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## The answer to a research fellows dream could be the 85, read on to find out why!

**A**fter my first tentative mutterings on the HP micro a couple of months ago it became clear that it was not going to be an overnight job to finish the thing off, so at long last, here is the remainder of the story. To briefly recap for those of you who missed the April issue the HP-85 is a personal, desktop microcomputer for professionals in both research and industry.

What, you may ask, is it doing between the pages of a "hobby" magazine? Well, quite apart from general interest - how did he get in here - it does represent the direction that personal computing is moving in.

### The Heart Of The Matter

We carefully took the lid off the box and . . . Figure 1 reveals the naked truth about where your money went. What you are paying for is research and development of a large number of custom designed ICs which perform all the boring tasks usually allotted to a board full of humble TTL. They even decided to make their own eight bit CPU, a decision that some people seem unhappy about. The overall result of this little piece of high tech is a professional unit, designed to last a lifetime and be very reliable.

For those of you with sharp eyes the lack of solder masking on the board is due to the fact that this is a demo model, HP even warned us about the possibility of damp causing memory problems! Never fear, your shop bought model will be masked and you won't need to keep it warm at night.

### Documentation

One word will suffice, superb. I detect a note of suspicion but you really can't find fault with the supplied material. Every facet of operation of the machine is covered in copious detail and the sections on programming are thorough to a fault. Software security is obviously not a worry to HP as they list all the programs in their Standard Pac along with other details, saving you the trouble of folding up all that

printout. Presumably they thought that any dedicated person could break down the security codes and saved you the problem. Whilst on the subject of programs it is worth noting that many of the answers to set problems are well worth saving.

Purists will say, and several have already, that no details of machine code are given. Although this is quite correct it hardly matters. At the moment I understand that some details of the assembly language are to be published in the HP newsletter for users, and that they are working on a variety of ROM Pacs. Since the ROM Pacs contain machine code and they are being supplied by HP a lot of effort can be saved.

### Of Numbers And Things

Many of you will have read of such things as Tiny BASIC and Integer BASIC and understand that they denote the number handling capabilities of the language. You could say the HP has a Fuller-than-most Scientific BASIC! This very impressive hunk of language sits somewhere within the top 24K and does quite a lot that others cannot do. The number handling capability is a variable in that you can specify one of three ranges. These are INTEGER which gives you -99999 to +99999, SHORT which offers -9.9999  $10^{-99}$  to 9.9999  $10^{99}$  or the default option of REAL which offers a massive -9.99999999999  $10^{-499}$  to 9.99999999999  $10^{499}$ . It makes good sense to specify those variables which only need to be of INTEGER and SHORT values as this saves an appreciable amount of memory. See Table 1.

All the usual mathematical functions are available with this version of BASIC, as are quite a few that you may not be so familiar with. A summary of the predefined functions is in Table 2.

### Filing Facts

The advantages of the HP cartridge system over the usual cassette are both many and varied. The system, as I men-

# HP 85 REVIEW

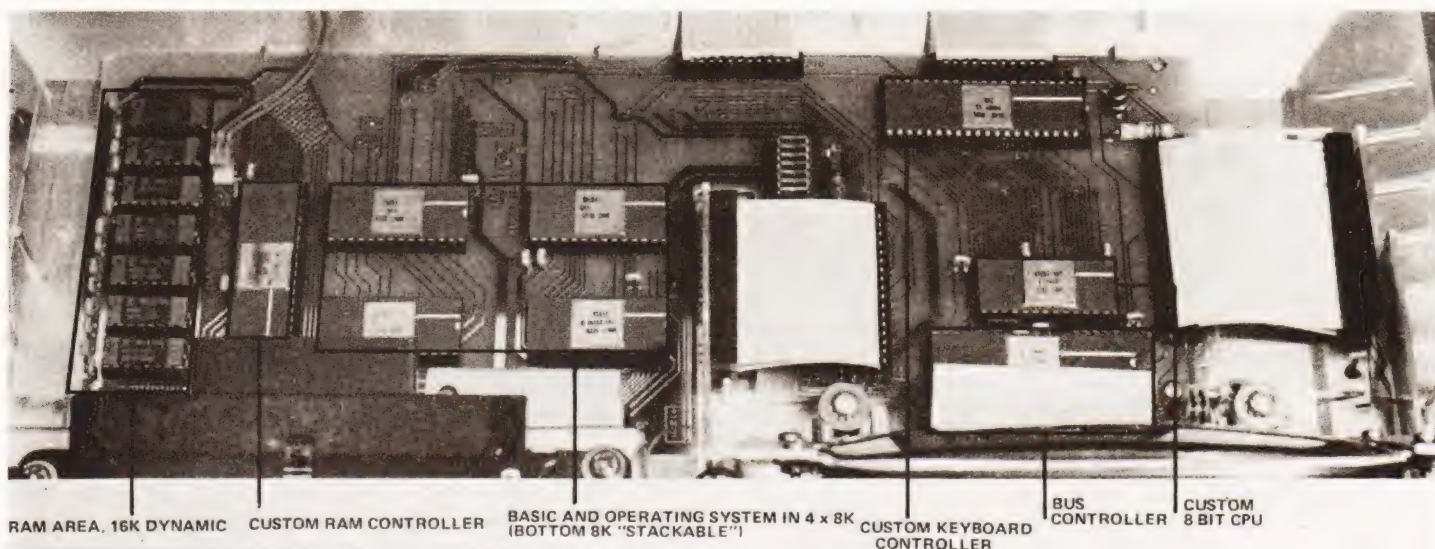


Figure 1. The CPU board laid bare!

Precision	Accuracy	Range	Maximum array size (standard memory, no program)	DTR(X)	Degree to radian conversion.
REAL	12 Digits	$\pm 9.999999999999E\pm 499$	1800	EPS	Smallest machine number (1E-499).
SHORT	5 Digits	$\pm 9.9999E\pm 99$	3600	ERRL	Line number of latest error.
INTEGER	5 Digits	-99999 through 99999	4800	ERRN	Number of latest error.
<b>Simple Variables</b>			<b>Bytes of Memory</b>	EXP(X)	$e^X$
Full precision		10 bytes		FLOOR(X)	Same as INT(X) (relates to CEIL).
Short precision		6 bytes		FP(X)	Fractional part of X.
Integer		5 bytes		INF	Largest machine number (9.999999999999E499).
String		8 bytes + 1 byte per character		INT(X)	Largest integer $\leq X$ .
<b>Array Variables</b>				IP(X)	Integer part of X.
Full precision		8 bytes + 8 bytes per element		LEN(S\$)	Length of string S\$.
Short precision		8 bytes + 4 bytes per element		LGT(X)	Log to the base 10 of X, $X > 0$ .
Integer		8 bytes + 3 bytes per element		LOG(X)	Natural logarithm, $X > 0$ .
<b>Table 1. How the HP uses variables and arrays, and what they cost in terms of memory.</b>					
ABS(X)	Absolute value of X.			MAX(X,Y)	If $X > Y$ then X, else Y.
ACS(X)	Arccosine of X, in 1st or 2nd quadrant.			MIN(X,Y)	If $X < Y$ then X, else Y.
ASN(X)	Arcsine of X, in 1st or 4th quadrant.			NUM(S\$)	Decimal character code of first character of S\$.
ATN(X)	Arctangent of X, in 1st or 4th quadrant.			PI	3.14159265359
ATN2(Y,X)	Arctangent of Y/X, in proper quadrant.			POS(S1\$, S2\$)	Searches string S1\$ for the first occurrence of string S2\$. Returns starting index if found, otherwise returns 0.
CEIL(X)	Smallest integer $\geq X$ .			RMD(X,Y)	Remainder of X/Y: $X - Y * IP(X/Y)$ .
CHRS(X)	Character whose decimal character code is X. $0 \leq X \leq 255$ .			RND	Next number, X, in a sequence of pseudo-random numbers, $0 \leq X < 1$ .
COS(X)	Cosine of X.				
COT(X)	Cotangent of X.				
CSC(X)	Cosecant of X.				
DATE	Julian date in format yyddd (assumes system timer has been set properly).				

RTD(X)	Radian to degree conversion.
SEC(X)	Secant of X.
SGN(X)	The sign of X: -1 if X < 0, 0 if X=0 and +1 if X > 0.
SIN(X)	Sine of X.
SQR(X)	Positive square root of X.
TAB(N)	Skips to specified column.
TAN(X)	Tangent of X.
TIME	Time in seconds since midnight (assumes system timer has been set properly) or since power on.
UPC\$(S\$)	Converts all lower-case alphabetic characters in S\$ to upper-case.
VAL(S\$)	Returns the numeric equivalent of the string S\$.
VAL\$(X)	String equivalent of X.

Table 2. Pre-defined BASIC functions that leave little to be desired.

tioned in the earlier report, uses a similar storage format to that of a soft sectored floppy disc. This results in both faster and more flexible access to the stored information. On machines such as the PET which use cassette, the main bulk of time is spent searching the tape to find the correct header. On the HP tape there is a directory, called CAT, and the program is first located in this - which gives its position on the tape - and the machine can then spool off to this absolute location, much quicker.

When you wish to save a program you merely have to hit the key labelled STORE and then type the name of your file in quotes, "FRED". The system then checks to see if you are allowing write actions to the tape - there is a hardware tab that can be set - and that's all. Recall of a program

Parameter	Value
Rewind time	29 seconds
Initialization time	15 seconds
Search speed	60 inches per second
Read/write speed	10 inches per second
Tape length	43 metres (140 feet)
Number of tracks	2 independent tracks
Typical tape capacity	780 program records (195K bytes) 850 data records (210K bytes)
Tape directory capacity	42 files (directory entries)
Typical access rate (search speed)	7,800 bytes/second
Typical transfer rate	650 bytes/second
Typical tape life (continuous use)	50 to 100 hours
Typical error rate	<1 in 10 <sup>8</sup> bits (that's less than one in every 100 million!)

Table 3. Mechanical details about the cartridge system.

Type	Secured against
0	LIST, PLIST, and edit.
1	STORE (duplication), LIST, PLIST, and edit.
2	STORE (overwriting), PRINT#, STORE BIN.
3	CAT (blank name in directory).

Table 4. Data security types and what they do.

is the reverse using the LOAD key, except that there is no read protection. (See Fig.2 for key layout).

All the usual PRINT# and READ# commands are available for data files. The operating system allows up to ten data files to be set up and used simultaneously during a program run. This unusual offering is performed by using buffers that only write to the tape when they are full.

Two methods of securing data are available. The first is the hardware tab that I mentioned a little earlier; the second is a set of commands that give up to four levels of protection on both program and data files. Mechanical details of the tape system are given in Table 3 and security levels are shown in Table 4.

The most powerful of all the commands associated

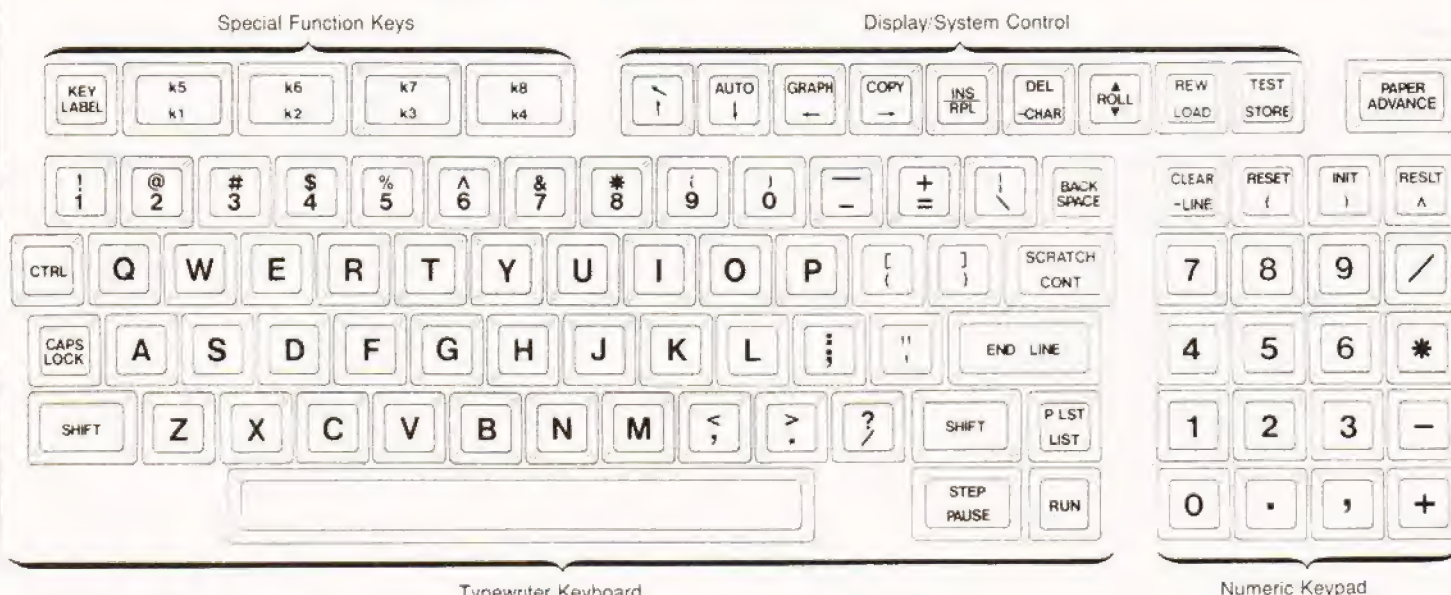
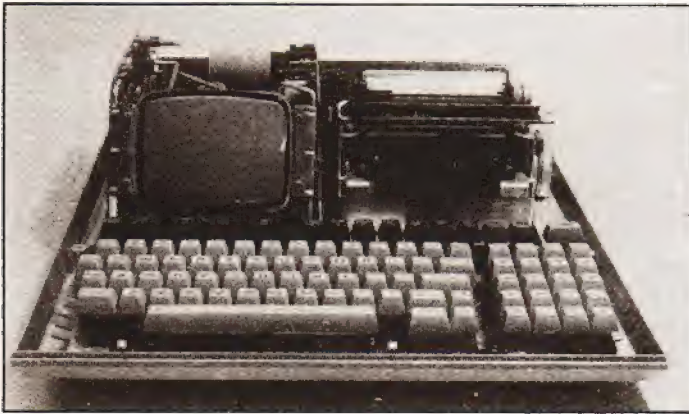


Figure 2. A key for every job and every job has a key.

# HP 85 REVIEW



Eat your heart out!

with the tape system must be CHAIN which allows one program to load and execute other programs, and if properly set up you can actually share or exchange variables between these programs.

### Pretty Printing

Both DISP and PRINT output statements can be made to conform to a predetermined format by using an IMAGE statement. Table 5 reveals the symbols that can be used but suffice to say that the range and flexibility is superb. For an actual example of their use in a program, the Multiplication example in the April issue used a formatted output on both screen and printer. Whilst on the subject it should be noted that if you can't remember to change your usual PRINTs to DISPs when loading a program in you can swop the roles in the machine by saying CRT IS 2 @ PRINTER IS 1. This is actually executable as a BASIC command so you can swop around within the running of your program. If you wanted to have everything printed out, a diagnostic run for example, you can simply say PRINT ALL, and it does!

### Diagnostics

Although functions such as STEP are provided on the keyboard, along with PAUSE and CONT, the HP also offers three TRACE functions. These can be programmed in to work on a certain section of code or executed from the keyboard to operate on the whole program, all information is printed. Between them they allow you to follow variables or program lines and really do make debugging a doddle.

Format character	Function
n(...)	parentheses allow field replication n times
A	string character
Z	digit position or leading zero
*	digit position or leading asterisk (*)
D	digit position or leading blank
.	decimal point (.)
S	sign (+ or -)
M	minus sign or blank
E	exponent in form ESDDD
K	use default format
X	blanks
R	comma radix (,)
C	comma (,)
P	period (.)
/	carriage return/line feed
" "	literal

Table 5. Format characters for "pretty printing".

Also worthy of note within this section on diagnostics is that the HP has a built-in test sequence initiated by keying TEST, which checks out all internals and prints out the character set with underlining. Why with underlining? Simple, the underline character occupies the top bit so this tests all the bits and not just the lower seven of the printer.

### Graphically Speaking

They say that a picture can be worth a thousand words and if that's true then the 85 must rate as quite an author. The power unleashed by just sixteen commands, see Table 6, is quite amazing. The flexibility is based around the system capability to address any of the available 49,152 dots on the screen which are arranged on a 256 by 192 grid. To compensate for the non-square nature of the screen it is possible to scale the X and Y axes independently. The maximum scale allowed is 100 by 100 but if you try to draw circles in the centre without correcting for the shape of the screen you tend to get ovals! The scaling factor is X-4/3 Y and it is not the nuisance that it might at first appear.

**ALPHA** Sets the display to alphanumeric mode.

### BPLOT character string, number of characters per line

Plots a group of dots on the graphics display as specified by the character string.

### DRAW x-coordinate, y-coordinate

Draws a line from the current pen position on the graphics screen to the x,y coordinate position specified.

### GCLEAR [y]

Clears the graphics screen from the specified y value to the bottom of the screen, or the entire screen if no parameter is specified, in current pen colour.

**GRAPH** Sets the display to graphics mode.

### IDRAW x-increment, y-increment

Incremental draw. Draws a line from the current pen position to the position determined by incrementing the current pen coordinates by the specified increment values.

### IMOVE x-increment, y-increment

Incremental move. Moves the pen from the current pen position to the position determined by incrementing the current pen coordinates by the specified increment values.

### LABEL character string

Writes a character string on the graphics display at the current pen position.

### LDIR numeric expression

Label direction. Specifies the direction for labels in graphics mode. Horizontal labels are specified by values less than 45. Vertical labels are specified by values greater than or equal to 45. Default label direction is horizontal.

### MOVE x-coordinate, y-coordinate

Moves the pen to the specified coordinate position without drawing a line on the graphics display.

## PEN numeric expression

Specifies whether the plotting is done with white dots or black dots. When the expression is positive, a white dot is specified; when it is negative, a black dot is specified.

**PENUP** Lifts the pen; inhibits line generation.

## PLOT x-coordinate, y-coordinate

Moves the pen from the current point to the specified location, drops the pen, and makes a dot. If the pen was down, draws a line from current point to specified point.

## SCALE x min, x max, y min, y max

Scales the graphics display in user-defined units. Default values are 0, 100, 0, 100.

## XAXIS y-intercept [, tic spacing [, x min, x max]]

Draws a horizontal axis on the graphics display. Tic marks and initial and final x values can be specified. Positive tic parameters specify the left side of the screen as a reference, negative tics specify the right side as a reference.

## YAXIS x-intercept [, tic spacing [, y min, y max]]

Draws a vertical axis on the graphics display. Tic marks and initial and final y values can be specified. Positive tic parameters specify the bottom of the screen as a reference, negative tics specify the top of the screen as a reference.

Table 6. The graphics commands.

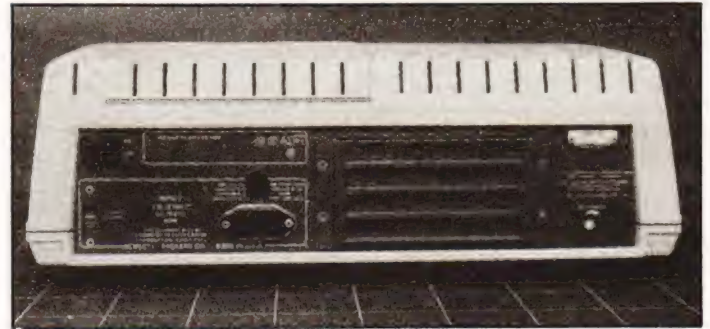
Having grasped the concepts of scaling things the manual leads you on into a vast array of powerful commands that take a little bit of time to come to terms with. For example you can draw a scale on your axes with 'tics' at determined intervals with a single command such as XAXISO,1. This gives the X,Y intercept a value of (0) on the X scale and puts tics at every interval on the predefined scale.

After scales and axes you begin to get a hankering to actually draw something, and here you find that the machine acts rather like a pen and paper. What you do is to specify the colour of your ink and that of the paper. This is done by PEN and PENUP commands. To move the PEN around you can DRAWx,y or PLOTx,y or MOVEx,y where the x and y are real co-ordinates on your screen. By adding a prefix of I to the MOVE and DRAW commands you specify incremental operation rather than absolute. Labelling your graphs is performed by the rather unusual command, LABEL and, as if that wasn't obvious enough, the orientation of the aforesaid label is controlled by LDIRn — where n is the 'angle' of the label.

By this stage of the game you have produced a screen full of straight lines and labels but what about curves? Well you can't draw curves as curves, you have to draw lots of little straight lines that make up a curve. If you make the lines short enough the curves are very good indeed. All the above graphic capability is easily mastered and is quite sufficient for most purposes, what comes next is not quite so easy.

## Shape Definition

It is possible to define a shape by character codes and plot these using strings. What you have to do is to draw the shape of your required 'object' on graph paper, the object now reduces to patterns of dots — each segment being one dot.



Neat uncluttered rear panel, with the Capricorn slots at the right.

Now, divide up the result into bytes and convert the binary value to decimal. All, all?, you have to do is to output the resulting string of characters using BPLOT. Figure 3 shows a triangle reduced to a string and the command BPLOT T\$,1 where T\$ is the string we are using. At this point I graciously admitted defeat and went onto something else. I'm quite sure that practice and careful study will make this function 'childs play' but trying to implement the functions in a crowded office is not the best idea.

	Binary Representation	Octal Value	Decimal Value
	0 0 0 0 1 0 0 0 0 0 0 1 1 1 0 0 0 0 1 1 1 1 1 0 0 1 1 1 1 1 1 1	0 1 0 0 3 4 0 7 6 1 7 7	8 2 8 6 2 1 2 7

Figure 3. Coding up for a character plot.

In summary the graphics are extremely powerful and flexible, you don't have access to pretty little spaceships and men but you do have the facility to produce them if you want, you can store them as data files even!

## Expansion

This section of any computer review is supposed to list a vast selection of esoteric goodies that you can hang on to the machine, not so this time. All that is currently available is a 16K RAM expansion and a ROM drawer. There will be floppy discs and a range of 'Capricorn to others' bus converters to allow connection of IEEE devices etc. It is unlikely that any special equipment will be developed as the expected use fits in with all the existing HP laboratory equipment — including atomic clocks — and most of the software merely needs to be converted from the minis.

## Conclusions

Having crept out of a research laboratory not so very long ago I can appreciate this as one of the machines that I would want on my bench (next to the PDP 8, but that's another story). My only regret is that it is expensive, a lower price would have meant volume sales and perhaps they are not geared up for that yet, we can only hope for a reduction in the next year.

The system is a true personal computer, not a machine for playing with, and as such represents the first of a new breed that will emerge over the next few years — serious machines for serious purposes. If HP ever feel generous I would love to have it back, permanently!

## Acknowledgements

We are indebted to Hewlett Packard of King Street Lane, Winnersh, Wokingham, Berkshire for the loan of the machine for a very generous period.

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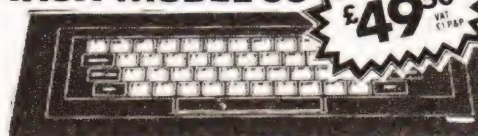
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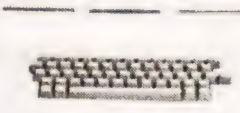
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## If converted bases sounds like a crossword clue you really do need this months Problem Page!

**W**hen the post arrives these days I view it with both anticipation and apprehension. It's not that I mind being wrong, it's just that the editor might get the wrong impression. My thanks this month go to Mr. Redman of Middlesex and Mr. Ball from London for pointing out that 11, 111, 111, 111, 111, 111, 111 is not prime but has factors 2071723 and 5363222357. Mr. Ball also proved that a little mathematical analysis will greatly speed up my solution to the Square and Add problem.

### What The Programmer Said

The programmer said 'There is, in this area, a sheep at least half of which is black', and that statement, as you can see, takes absolutely nothing for granted.

### Biggest Of Three

No, it's not ABSolutely impossible, the solution is given in figure 1. The ABS function is used, and if you are not sure how this works I hope the following explanation will help.

The function always returns a value greater than or equal to zero, ie. it is usually positive and *never* negative. The argument (the bit inside the brackets) is evaluated and if this gives a negative value the sign is changed, if the result is positive the ABS function appears to have no effect. For our problem the argument is the difference between two numbers and the positive difference returned gives the same result as if we had subtracted the smallest from the largest. So if A is less than B then  $(A+B+ABS(A-B))/2$  gives the following result :-

$$\begin{aligned} & \text{smallest} + \text{largest} + ABS(\text{smallest} - \text{largest}) \\ & \text{which equals } \text{smallest} + \text{largest} + \text{largest} - \text{smallest} \\ & \text{which equals twice the largest number} \end{aligned}$$

Therefore,  $(A+B+ABS(A-B))/2$  will always return the value B. If we take the case where A is greater than B then we find that the value of A is always returned. The rest of line 200 merely repeats the process to find the biggest of three numbers.

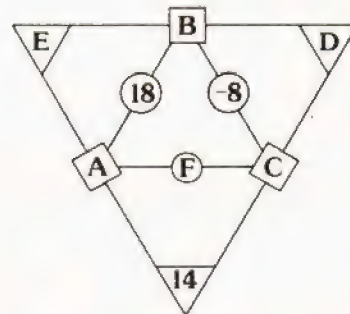
### Base Changing

The first solution (figure 2) prints a table (figure 3) which allows you to convert a small denary number into its hexadecimal equivalent. I'm afraid it's system dependent so unless you have a PET and 3022 printer, you will have to modify it. The second solution (figure 4) was also written on the PET but should be much easier to adapt. The method used is explained in the flowchart (figure 5). However, the aim was to produce a program which not only worked, but was easy to use as well. The PET has the annoying habit of returning to BASIC if only 'return' is pressed in response to an input statement. Lines 330 and 340 position a character under the cursor. If the user types something, this character is overwritten and therefore ignored. If the user merely presses 'return', however, the character is entered and used for the error routine. If you use a machine other than a PET, and it

too has its little foibles try to convert the program so that the unwary are not trapped. After all, if everyone was a computing expert, some of us would be out of a job!

### Find The Numbers

Following my theme of finding the strengths and limitations of the computer, I feel that it is time to examine a new technique. My solution will not necessarily be mathematically elegant but will try to use the computer's ability to the full. It's normally better to use a method you fully understand than a mathematical technique which is beyond you.



Given that the numbers in the circles are the sums of the numbers in the two squares to which they are connected, and that the numbers in the squares are the sums of the numbers in the two triangles to which they are joined, find the values of A, B, C, D, E and F.

The solutions to this problem are all whole numbers, so you should be able to do it even if you do not possess a machine.

```
100 INPUT A, B, C
110 PRINT (C+(A+B+ABS(A-B))/2+ABS(C-ABS(A+B+
      ABS(A-B))/2))/2
120 END
```

Fig.1. A short sort.

```
190 OPEN1,4
200 PRINT#1 :PRINT#1
210 N$="0123456789ABCDEF"
220 M$=" 123456789ABCDEF"
230 PRINT#1, TAB(8);
240 FOR J=0 TO 9
250 PRINT#1, " ";MID$(N$,J+1,1);" ";
260 NEXT J
270 PRINT#1 :PRINT#1
280 PRINT#1, TAB(5);" * "
290 PRINT#1, TAB(5);" * " :PRINT#1, TAB(5);" * "
300 FOR I=0 TO 300 STEP 10
310 PRINT#1, I;
320 IF I=0 THEN PRINT#1, " ";
330 IF I < 100 THEN PRINT#1, " ";
340 PRINT#1, " * ";
350 FOR J=0 TO 9
360 LET N=I+J
370 LET D0=INT(N/256)
380 LET D1=INT((N-256*D0)/16)
390 LET D2=N-16*D1-256*D0
400 PRINT#1, MID$(M$,D0+1,1);MID$(N$,D1+1,1);
      MID$(N$,D2+1,1);" ";
```



# PROBLEM PAGE

```

410 NEXT J
420 PRINT#1 :PRINT#1, TAB(5);" ☐ "
430 NEXT I
440 CLOSE1
450 END

```

Fig.2. Method one of producing a conversion table.

	0	1	2	3	4	5	6	7	8	9
0	00	01	02	03	04	05	06	07	08	09
10	0A	0B	0C	0D	0E	0F	10	11	12	13
20	14	15	16	17	18	19	1A	1B	1C	1D
30	1E	1F	20	21	22	23	24	25	26	27

Fig.3. A small sample of output produced by the above program.

```

100 DIM A$(25),B$(16),C$(16)
110 FOR I=1 TO 16
120 READ B$(I)
130 NEXT I
140 FOR I=1 TO 16
150 READ C$(I)
160 NEXT I
170 PRINT "[CLS] [3CD]
180 PRINT "[REV] "
190 PRINT "[REV] BASE CHANGE"
200 PRINT "[REV] "
210 PRINT "[3CD] YOU GIVE ME A BASE TEN
NUMBER AND"
220 PRINT "AND I WILL SHOW YOU HOW IT WOULD
BE"
230 PRINT "REPRESENTED IN BASES TWO TO
SIXTEEN"
240 PRINT "[3CD] "
250 PRINT "PLEASE PRESS RETURN AFTER TYPING
IN"
260 PRINT "YOUR NUMBER. THE NUMBER MUST BE"
270 PRINT "BETWEEN 1 AND 9999999 OR I WILL
STOP."
280 PRINT "[3CD] "
290 DATA 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F
300 DATA ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,
EIGHT,NINE,TEN
310 DATA ELEVEN,TWELVE,THIRTEEN,FOURTEEN,
FIFTEEN,SIXTEEN
320 PRINT "[CLS] BASE TEN NUMBER";
330 INPUT " .[2CL] ";XS
340 IF XS="" THEN GOTO 320
350 LET X=VAL(X$)
360 IF X=INT(X) THEN 380
370 PRINT "SORRY --- ONLY WHOLE NUMBERS
ACCEPTED":PRINT:GOTO 320
380 IF X=0 OR X > 10^7 THEN 600
390 PRINT
400 PRINT
410 PRINT "THE BASE TEN NUMBER";X;" IS :-"
420 PRINT
430 FOR K=2 TO 16
440 LET A=X
450 LET I=0
460 LET A1=INT(A/K)
470 LET R=A-K*A1

```

```

480 LET I=I+1
490 LET A$(I)=B$(R+1)
500 LET A=A1
510 IF A <> 0 THEN 460
520 PRINT TAB(25-I);
530 PRINT A$(I);
540 LET I=I-1
550 IF I > 0 THEN 530
560 PRINT "BASE";C$(K)
570 NEXT K
580 PRINT
590 PRINT
600 GOTO 320

```

Fig.4. Base changing for beginners, lines 330 and 650 are of general interest for any PET program.

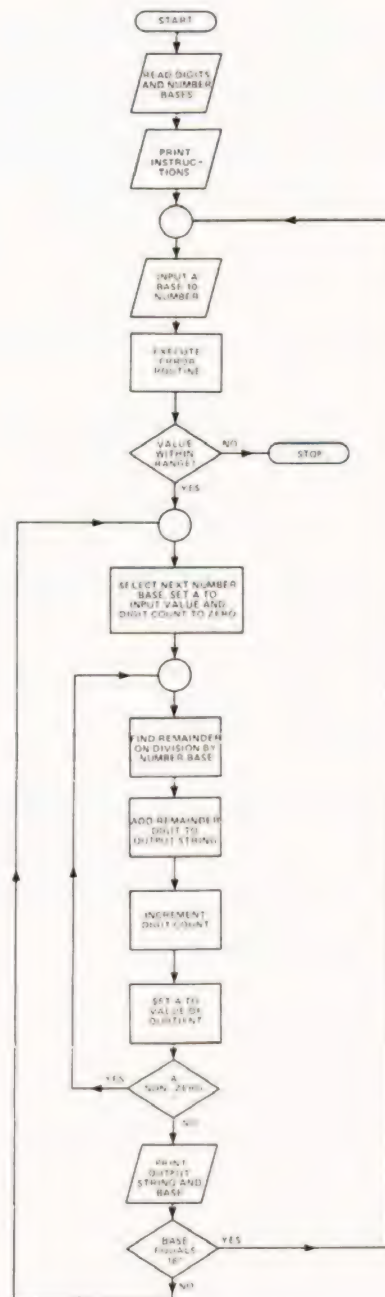


Fig.5. Flowchart explaining the above program.

# TRS 80 SOFTWARE

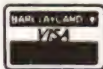
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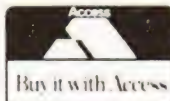
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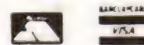
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# MPUs BY EXPERIMENT

Ian Sinclair

## Ian Sinclair tidies up the loose ends of his popular series.

One item we have to look at before we wind up is the interrupt system. We'll be dealing with another aspect of this shortly when we look at the single-step arrangement, but one very useful aspect of the INS8060 is its 'non-committed' interrupt system. This makes use of an input referred to as STATUS B or SB which is on number 28 of the large top edge connector, counting from the left hand side. What does it do?

```
0F20 06 CSA
0F21 C8 ST
0F22 02
0F23 3F
```

Gives 28, which in binary is 0010 1000

$$S_B = IE$$

Now try the same program with  $S_B$  connected to earth.

Fig.1. A short program for checking the STATUS register, with  $S_B$  left floating (unconnected). Try also the effect of earthing the  $S_B$  input.

### This Is What It Does!

Try out the short program of Fig.1. This starts by copying the status register to the accumulator. If you have just switched on, or have just reset, then there shouldn't be any rubbish in this register. The program stores the contents of the status register in 0F24, so that they appear as data.

BIT	7	6	5	4	3	2	1	0
USE	CY/L	OV	SB	SA	1E	F2	F1	F0

CY/L -- CARRY/LINK  
 OV -- OVERFLOW  
 SB,SA -- STATUS BITS  
 IE -- INTERRUPT ENABLE  
 F0,1,2 -- FLAGS

Fig.2. The functions of the bits in the Status register. Each bit is used in a different way, unlike the eight bits in the other registers.

This gives the answer 28, which in binary is 0010 1000. Fig.2 shows the layout of the status register, revealing that the two bits which are set are SB and IE. SB is set because its input is open-circuit and has floated high to logic 1. IE is the interrupt enable, and it has been set by the monitor for reasons which will become apparent later.

O.K. so far? Now with everything switched off, carefully run a link from SB output (edge connection 28) to a spare earth line on the Eurobreadboard. If you want to be ultra-smart, you can run two lines, one from SB input, the other from earth, to a toggle switch — I'd never have the patience! Whatever way you've done it, earth SB and run the program of Fig.1 again. What do you get this time?

Yes, the monitor program still keeps the IE bit set, but SB is now at 0, so the result is 08, not 28. Do you begin to see possibilities? For a bit of inspiration, try the program in Fig.3. It copies the status register to the accumulator, compares with 28, and loops back if the status register did not contain 28. The display goes out, because there's nothing to display. If we now let SB float, by removing the load from

the Eurobreadboard line, or by using the 'de-luxe' toggle switch the program can come out of the loop, and will display D0 at address 0F2A.

```
START 0F20 06 CSA
      0F21 E4 XRI
      0F22 28
      0F23 9C JNZ
      0F24 FB to START
      0F25 C4 LDI
      0F26 D0
      0F27 C8 ST
      0F28 02
      0F29 3F OUT
```

Fig.3. Using the SB input as a detector, causing the program to break out of a loop.

Simple, isn't it? The interesting thing is that it lets us control what's happening from outside, going from a looping program to a linear one at the flick of a switch. We didn't need to make the steps after JNZ a linear program, we could have had another loop, like a message display for example. The useful thing about the SB interrupt is that it leaves you free to decide what you want to do when the SB input goes high or low (yes, low — you could just as easily recognise 08 with the XRI as 28), and this is something that only the 8060 will permit so easily. The more usual type of interrupt system is the one which the 8060 also has in the form of the SA interrupt.

### Another Interruption

SA is another part of the status register (see Fig.2). When SA is high and IE is set, the microprocessor automatically executes a 3F — the program counter exchanges with pointer number 3. To use this interrupt system, then, you need to have some address set into pointer number 3, and the program which starts at this address in P3 must 'service' the interrupt — do something which stops the interrupt from interrupting! This is not completely straightforward on the Mk 14, because the monitor uses the 3F instruction. What has to be done is to load P3 with the address of the interrupt early in the program, and re-load it with the monitor address at the end of the program — but that comes into the realms of more advanced programming!

### Insecticide Section

One topic we must cover before we leave you is the subject of how to write bug-free programs. After a few years you get quite good at this, and you can dash off a program which will run faultlessly. Until you arrive at that happy state (and some of us never do!) you need to be able to write, check and amend programs until they run perfectly. The scheme which follows is not novel, but it needs to be stated, because you never seem to see it anywhere else. Another first for CT!

Start by writing the program on paper, with each address number written in. Waste of time? Don't you believe it — a few minutes writing can save you hours of frustration sitting in front of the Mk 14 wondering why a program won't run. Whether you draw a flowchart, or not is a matter of personal choice — some do, some don't, as the Bishop observed of actresses! A written program is a must, though. Now look at it! First of all check that each quantity you want to use is loaded in from the correct position, and stored out to the correct address. If you like (and I do), leave a blank after each load or store instruction to put in the displacement later; do the same after each jump. You can then

spend a happy few minutes putting in the displacements. For load or store type of instructions (and that includes AND, OR, XOR, DAD, ADD, CAD) count the number of address steps from the address *where the displacement is to be* to the address of the memory you are using. Then convert this into a hex displacement. If this is a negative number, the conversion method is shown in Fig.4. For a jump, you have to count to the step *immediately before* the place you want to jump to. For example, if the displacement number is to be at 0F25 and you want to jump to 0F2A, that's a jump of 04 to go in at 0F25. On the other hand if your displacement number is at 0F28 and you want to jump to 0F20, you aim for 0F1A, which is a displacement of -9 (decimal), and that's F7 in hex. These displacements can, incidentally be put in when you are entering a program, using the hex displacement part of the monitor program of the Mk 14.

1. Convert the number to binary (8 bit)
2. Take the 2's complement
3. Convert to hex

Example : -10

8 bit Binary 10 is 00001010  
 2's comp is 11110110  
 Hex --- F6

Fig.4. Conversion of negative numbers to HEX-code.

All displacements need careful checking, because if a displacement is wrong, it can cause havoc in a program. It isn't just that it can cause a program to crash, that's the least of it. The real catastrophe is that it can cause extensive corruption, because bytes are loaded in where they've no right to be. If the program uses a lot of loops, you can sometimes find practically every data byte changed after one run! If you've spent a lot of time entering the program, you won't like it! As an obvious conclusion, it pays to step right through any program using Mem, after it has crashed, to see if any bytes have been corrupted.

This preliminary paperwork can help greatly, but it's likely that a few bugs may remain. How do we deal with them? The software method is to insert breaks. This means selecting a place in the program and slapping in 3F instead of the instruction which is normally there. When we run the program, it will return to monitor when it meets the 3F instruction. We can then find out what is in each register by keying up addresses 0FF9 on. Remember that 0FFD contains the contents of the accumulator, so you can check to see if a load instruction has been correctly carried out. If all is well, you can then remove the 3F, insert the correct instruction, and repeat this procedure later on in the program. If the 3F is put in after a store, for example, the address of the store can be keyed in when the program returns to monitor, to check that the data has gone correctly to store. With a bit of luck, a lingering bug can be exterminated this way.

#### Stepping Out

There's another very powerful method which I used extensively on the two longer programs of this series — the single step method. This is a 'hardware' method, and it needs a bit of extra circuitry which is detailed in the Mk 14 manual on page 15. The S of C circuit makes use of a 7493A, which isn't the sort of IC we're likely to find in the drawer. If you have a couple of 7476's and a 7400 (they're common

enough!), though, you can slap up this circuit on the Eurobreadboard (what would I do without it? What indeed!) as shown in Fig.5.

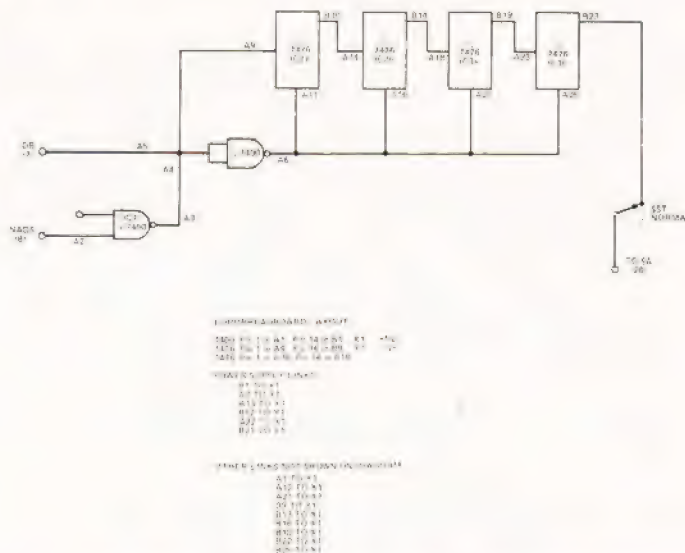


Fig.5. The circuit for a single-step controller. The connections for a Eurobreadboard version are shown, using two 74LS76 and one 74LS00 IC in the positions shown. With the switch in its single-step position, the program will perform one complete step each time the GO button is pressed.

The single-step isn't easy to explain because it depends very much on what the monitor does and how the controls interact. Basically, it depends on the principle of using the SA interrupt input to return a program to monitor, just as if you had put a 3F after each complete step. Complete step means, for example, a load and its displacement; you can't step between these two. The 7476's (our version) or 7493A (S of C) act as a count of 16 steps after resetting. The reset is carried out when the HALT instruction occurs at address 001C in the monitor program, because the coincidence of NADS (negative pulse) and DB7 (positive) is gated to produce a reset. After that, each NADS pulse, which occurs whenever an address is fetched, will cause the counter to increment, and when the count reaches 1000 (decimal 8) the output of the counter is set to 1, so that SA is set. This causes a return to monitor, displaying a program step. The counting is cunningly arranged to allow a single complete step of your program on each press of the GO key. This is undoubtedly the Rolls-Royce method of debugging a program, as you can see exactly what the effect of each step is. Since the system has returned to monitor, you can dial up any address you like to look at, providing you return to the exact address at which the program stopped — I usually tick this place on a program as I go through. As before, you can check memory address for correct storing, or the accumulator contents (at 0FFD) for correct loading. Best of all, you can see from the address display whether a jump has gone the right way or not.

The only time when single stepping has to be abandoned is when a large countdown or a delay has been programmed. Unless you really fancy pressing the Go key several hundred thousand times, it's best to use Abort to address yourself to a point just after a delay and then single step from there. For a large countdown, just check a few loops, then enter a number near the end of the loop count into the accumulator at 0FFD and single step the last count or so.

With a single-stepper, you can make virtually any

# MPUs BY EXPERIMENT

program bug-free, so you have total freedom to write and check longer programs. You might, at this stage, consider the extra RAM for the Mk 14. If you do instal the extra, the best method of using it initially is to keep the new chunk of RAM which starts at address 0B00 for data (tables, in particular) and to continue entering programs at 0F20. If you absolutely insist on writing a program which overlaps one chunk of memory and goes into the other, you will need a step to direct your program — you can't expect the MPU to know that the step at 0FF8 is followed by one at 0B00 or the other way round. The easiest method is to use a P1 relative jump at the end of one RAM, with P1 loaded to the starting address of the next one. The next part of the program can then load P1 to the address of the previous RAM, in case you want to go back again, and so to the rest of the program.

## Back In Store

Things are beginning to look a trifle complicated now, and you will greatly resent the fact that you lose your program each time you switch off. The obvious way round this is the Mk 14 cassette interface, which is particularly good value, or you could try CT's own. Remember, whatever you do, to use sockets (not supplied) for the two CMOS ICs, and watch the polarity of the LEDs. Looking at the back of the PCB, you can see the earth strip — the cathodes of the LEDs go on this strip, whatever the instructions say! The interface works very well, but it's advisable to save each program twice to allow for possible tape dropouts. A double save is a standard procedure which can save a lot of time and trouble in chasing

corrupted programs. Note, by the way, that the leaflet which comes with the cassette interface shows the save and load programs. These are for interest only, because they are incorporated into the monitor on the Issue 5 machines. The instructions are in the Mk 14 manual, on page 18. Note that only 256 bytes can be entered — if your programs are longer than this you'll need more than a cassette interface, because the RAM on board is only 256 bytes long unless you've added the INS8154 as well.

## VDU 4U 2 C

At the time of writing, the video interface had just been announced, but I haven't tried one. My feeling is that it's rather a lot of extension to what should basically be kept as a simple system, but if you're Mk 14 hooked then you might like to take a look at it.

Finally, a word on software. Software is expensive, unless you collect it within the covers of CT! The programs which have appeared in this series are specifically written for the Mk 14, which isn't necessarily the case for others, even if they are advertised as of interest to Mk 14 owners. Several books which deal with 8060 programs assume the use of a different monitor program, so that you would have to adapt the programs carefully. All in all, if you haven't got the hang of the Mk 14 programming from this series, you probably won't get it from books. Keep an eye open for machine language programs for 8060 (SC/MP 2), and be prepared to modify programs and to write your own — that way you'll learn much more, and your programs will be more useful to you.



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Ammo and cursor speed can be found at 0F1C and 0F38 respectively for the meddlers amongst us.

Just the thing for working off a few complexes and aggressions!



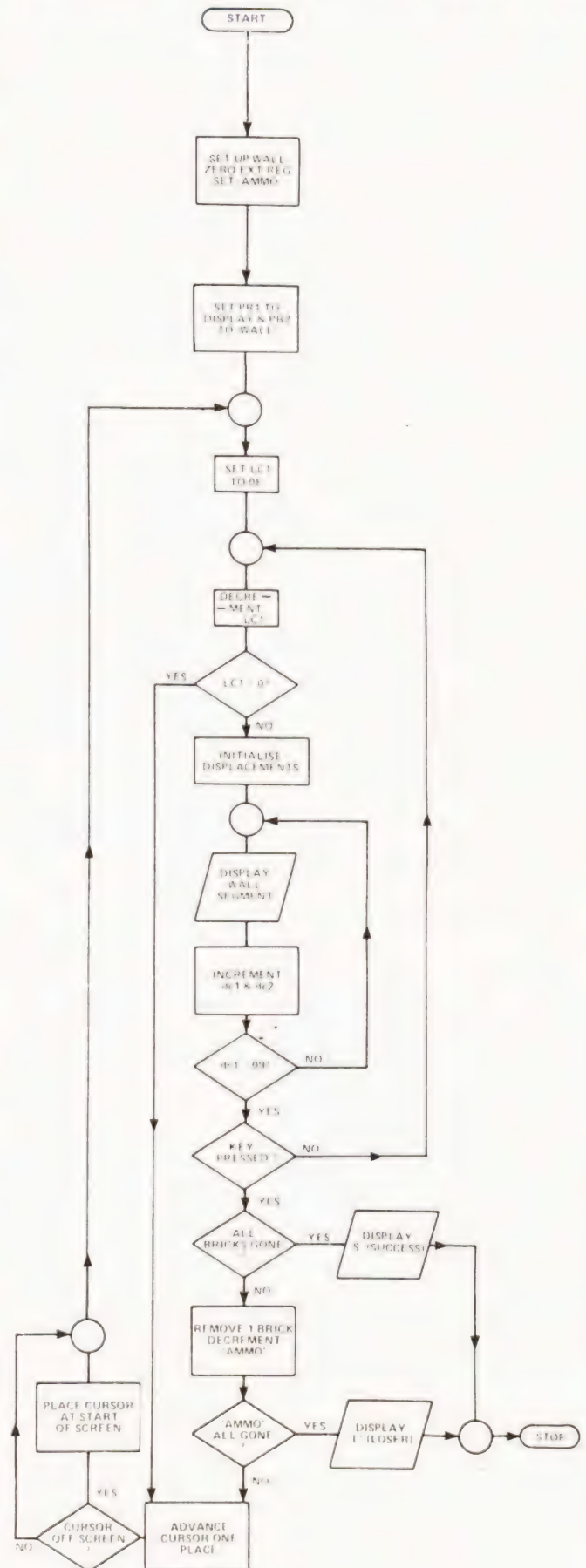
## Program Listing

0F12	START	C4 0D	LDI		0F43	C4 74	LDI		
0F14		35	XPAH 1		0F45	C8 06	ST	DC2	
0F15		C4 0F	LDI		0F47	LC1	C4 XX	LDI	
0F17		36	XPAH 2	P2 TO WALL	0F49		8F 05	DLY	SLOW CURSOR
0F18		C4 C0	LDI		0F4B	DC2	C0 XX	LD	LD WALL SEG
0F1A		32	XPAL 2		0F4D	DC1	C9 XX	ST(1)	DISPLAY IT
0F1B		C4 06	LDI	SET AMMO	0F4F		A8 FC	ILD	DC2
				VALUE	0F51		A8 FC	ILD	DC1
0F1D		CA FF	ST(2)	AMMO	0F53		E4 09	XRI	END OF LOOP?
0F1F		C4 7F	LDI	SET UP WALL	0F55		9C F0	JNZ	NO SO GOTO
0F21		CA 00	ST(2)						LC1
0F23		C4 49	LDI		0F57		A9 00	ILD(1)	KEY PRESSED?
0F25		CA 01	ST(2)		0F59		08 08	NOP	
0F27		CA 02	ST(2)		0F5B		98 DE	JZ	NO SO GOTO
0F29		CA 03	ST(2)						LOOP
0F2B		CA 04	ST(2)		0F5D		C2 80	LD(2)	EXT AS
0F2D		CA 05	ST(2)						OFFSET
0F2F		CA 06	ST(2)		0F5F		E4 36	XRI	HOW MANY
0F31		CA 07	ST(2)						BRICKS LEFT?
0F33		C4 00	LDI	PLACE CURSOR	0F61		98 40	JZ	NONE SO GOTO
0F35		01	XAE						WIN
0F36		08	NOP		0F63		E4 08	XRI	
0F37	SET	C4 0E	LDI	LOOP 0E TIMES	0F65		98 10	JZ	ONE
0F39		C8 0E	ST	LC1	0F67		E4 40	XRI	
0F3B	LOOP	B8 0C	DLD	LC1	0F69		98 06	JZ	TWO
0F3D		98 40	JZ	TO MOVE	0F6B		C4 7E	LDI	THREE,
0F3F		C4 00	LDI	SET UP					REMOVE ONE
				DISPLACEMENTS	0F6D		CA 80	ST(2)	EXT AS OFFSET
0F41		C8 0C	ST	DC1	0F6F		90 0A	JMP	
					0F71	TWO	C4 3E	LDI	REMOVE ONE
					0F73		CA 80	ST(2)	EXT AS OFFSET
					0F75		90 04	JMP	
					0F77	ONE	C4 36	LDI	REMOVE ONE

# ANOTHER BRICK IN THE WALL

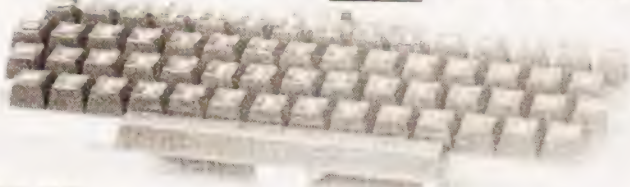


0F79		CA 80	ST(2)	EXT AS OFFSET
0F7B		BA FF	DLD(2)	AMMO
0F7D		98 1E	JZ	LOSE
0F7F	MOVE	C2 80	LD(2)	EXT AS OFFSET, REMOVE CURSOR
0F81		E4 36	XRI	
0F83		CA 80	ST(2)	EXT AS OFFSET
0F85		40	LDE	MOVE CURSOR
0F86		F4 01	ADI	
0F88		01	XAE	
0F89		40	LDE	
0F8A		08	NOP	
0F8B		E4 08	XRI	
0F8D		9C 04	JNZ	
0F8F		C4 00	LDI	
0F91		01	XAE	
0F92		08	NOP	
0F93		C2 80	LD(2)	EXT AS OFFSET, PLACE CURSOR
0F95		E4 36	XRI	
0F97		CA 80	ST(2)	EXT AS OFFSET
0F99		8F 7F	DLY	
0F9B		90 9A	JMP	TO SET
0F9D	LOSE	C4 38	LDI	DISPLAY L (LOSER)
0F9F		C9 00	ST(1)	
0FA1		90 FA	JMP	TO LOSE
0FA3	WIN	C4 6D	LDI	DISPLAY S (SUCCESS)
0FA5		C9 00	ST(1)	
0FA7		90 FA	JMP	TO WIN



Flowchart for the game.

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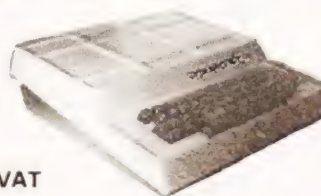
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21102	98	8T28		1.90
2114	4.50	8T85		1.57
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# PRINTOUT

Dear Sir,

Following Mr. R. Cason's question on the PET (Computing Today, April, 1980) concerning rescuing data from a tape where the header has been accidentally erased, may I offer the following.

If a data tape is concerned the problem is relatively simple. There are basically two methods, one is to use "GET" and the other is "INPUT". Since the latter is more straightforward let me deal with this first.

First of all enter the following program :

```
10 OPEN 1
20 STOP
40 INPUT=1, A$
60 PRINT A$
50 IF (ST) AND 64 GOTO 110
100 GOTO 40
110 CLOSE 1
120 END
```

The technique is to place in the cassette player a data tape with the header intact. Run the program in the normal way until it breaks in line 20 then switch off the cassette deck and substitute the corrupted tape for the original one having first wound it to approximately the right place. Now enter the command "CONT" and press "Play" on the cassette deck. The lost data will now be retrieved from the tape and displayed on the screen.

The problem now is formatting it. Data will scroll up the screen at a rate of knots and be lost before it can ever be read. A semicolon at the end of line 60 will help but string data will butt up with no spaces between and still be difficult to read; even if a comma is used instead of a semicolon readability is not certain, depending on the length of strings, and in any case the whole thing will still be moving too fast to copy out. Of course a printer would get you out of this problem.

The best way to control the stuff is to add the following lines to the program :

```
30 FOR I = 1 TO 20
70 NEXT
80 WAIT 59410, 4, 4
90 PRINT "clear"
```

Line 100 should be changed to 100 GOTO 30.

Now twenty items of data are displayed and the thing stops until you press the space bar whereupon the screen clears and the next twenty items are shown.

The "WAIT" may not work on old ROMS so line 80 can be changed to :

```
80 GET Q$: IF Q$ = "" GOTO 80
```

and any key can be used to advance to the next block of data.

The method using "GET" is basically the same in fact but the data cannot be formatted in the same way as with "INPUT". The information will only be displayed in a column down the left hand side of the screen unless a comma is used in line 60 when on character only will appear in each of the four pre-tabulated columns. Since the "GET" will release 20 characters at a time with the program as it stands some strings will be split unless line 90 is omitted which will stop the screen being cleared.

Actually the only advantage in using "GET" is to find out just what is on the data tape character by character including cursor control characters and carriage returns.

This is done by amending line 60 to :

```
60 PRINT ASC (A$)
```

when the ASCII number corresponding to each character will be shown instead of the character itself. This would really seem to be more of academic interest than of practical value. Another point to watch when using "GET" is that when it comes to the end of file marker it will return an error condition and leave the program. Line 50 tests the status (ST) which will be 64 when the EOF is reached; "INPUT" reads this successfully and ends the program.

If the corrupted recording is actually a program rather than data, retrieval is still possible but is technically more complex. It would need rather a long letter to deal with this so if the editor feels there is sufficient interest I would be prepared to write a short article to explain the method.

Yours faithfully,  
Alan W. Shelley.

L'Abri 2 Hadlow Road,  
Sidcup, Kent DA14 4AF



"... AND I PROGRAMMED IT TO FETCH MY  
COMPUTING TODAY - MAGAZINE!"

Dear Sir,

After reading the article "Machine Code Course" (April), a statement is made, referring to the "FLAG" register that they "cannot be written into by the user", and I felt that with this article being in the "learning or teaching" range of articles, that this statement is misleading and untrue, the "Flags" register can be loaded with any desired data, though indirectly :-

```
ie LOAD the 'L' register with the desired value.
PUSH 'HL'
POP 'AF'
```

The data loaded to the 'L' register is now in the 'F' (FLAG) register, if the 'A' register is first loaded to the 'H' register, then only the "FLAGS" have been modified.

Yours faithfully,  
R. Yates.

53, Briarfield Road,  
Withington,  
Manchester 20,  
M20 6SS

Dear Editor,  
Re. MICRO-FI Recording Standards

There seems to be emerging a clear and useful role for the cheap cassette recorder in computing in spite of loud roars from 'diskites' madly spending other people's monies on micro-second response systems.

The occasional (justified?) moans from reviewers that this or that new micro has cassette reading difficulties might be alleviated if the 'Micro-Press' would take a lead in defining a MICRO-FI recorder specification thereby separating the suppliers who can't do from those who don't know.

I am not a recording specialist but, just to get the ideas rolling, I offer the following as 'starters' to be vetted by suitably equipped experts on the cheapest recorder in the market place (after chopping out the odd resistor or so put in to make Aunt Annie's singing into pseudo HI-FI!).

The MICRO-FI Standard . . . . .

1. Considers all frequencies below 1200 Hertz and above 2400 Hertz to be outside the standard and may be removed at will.
2. Assumes a standard source signal to be (say) 1.0 Volt Pk-to-Pk either sine or square wave applied across a load not less than 1 k ohm in the recorder.
3. Assumes the recorder, operating at maximum volume setting, is able to saturate the cassette media using only DC bias (to levels defined by mag tape wizards . . . .).
4. Assumes that the recorder on replay, and given a cassette recorded as in 3 above, must be able to deliver, at maximum volume setting, at least the fundamental frequency of 1200 or 2400 Hertz (+ or - usual speed variations). The minimum output signal must be 1.0 Volt Pk-to-Pk across a load not less than (say) 10 Kohm.

Three minutes after the wizards have finished revising my values they can dash off a brief DIY article on converting cheapo POP-FI recorders into rock-steady, no AVC, no nonsense MICRO-FI recorders.

Yours faithfully,  
 P.V. Slee.

39/40 Portsmouth Road,  
 Artington, Guildford GU3 1 LN

P.S. A crude appeal to the editor's healthy avarice! As soon as the standard is established how about selling off the stacks of disc junk your staff have bought and after giving them a few fifteen quid recorders invest the balance in a proper editorial desk, chair, and etcs. (especially the etcs.).

Dear Sir,

As I own a Mk 14 I enjoy reading articles in your magazine about it, especially the series MPUs by experiment. However in April's article the program given for a moving message doesn't work! After spending a pleasant Easter Monday trying to find the mistake I eventually located it. The data byte at address 0F39 should read E5 instead of EA.

Keep up the articles on the Mk 14!  
 Yours faithfully,  
 Mr. W.R. Osborne.

8 Rotherfield Gardens,  
 Gateshead,  
 Tyne & Wear,  
 NE4 7TL.

Dear Editor,

Mk 14 Microcomputer

I write to you in an attempt to overcome a problem of obsolescence relating to the above computer. As an owner of an early version of this unit - with the old monitor - my interest in its uses has been renewed by recent articles in your magazine.

I now wish to update my unit so that further work can be undertaken, but having written to Science of Cambridge twice in the last fortnight concerning the availability of the following items

- Cassette interface
- Prom programmer
- Revised Monitor
- Extensions to 4K of RAM.

I am now told that these items are no longer available nor is there any circuit data so that I could produce my own.

Can you assist me by suggesting an alternative source or direct me to where this information could be located - such as a back issue of your magazine.

It seems ironic that whilst there are regular articles to be found on this machine, the makers cannot, or wish not, to supply further units.

I do hope that you can be of assistance and I look forward to hearing from you in due course. Thanking you in anticipation.

Yours sincerely,  
 A.S. Waddington.

2 Larch Close,  
 Stratford-upon-Avon,  
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 CV37 6XJ.



"THAT'S JOHNSON - JUST BEEN REPLACED BY A COMPUTER!"

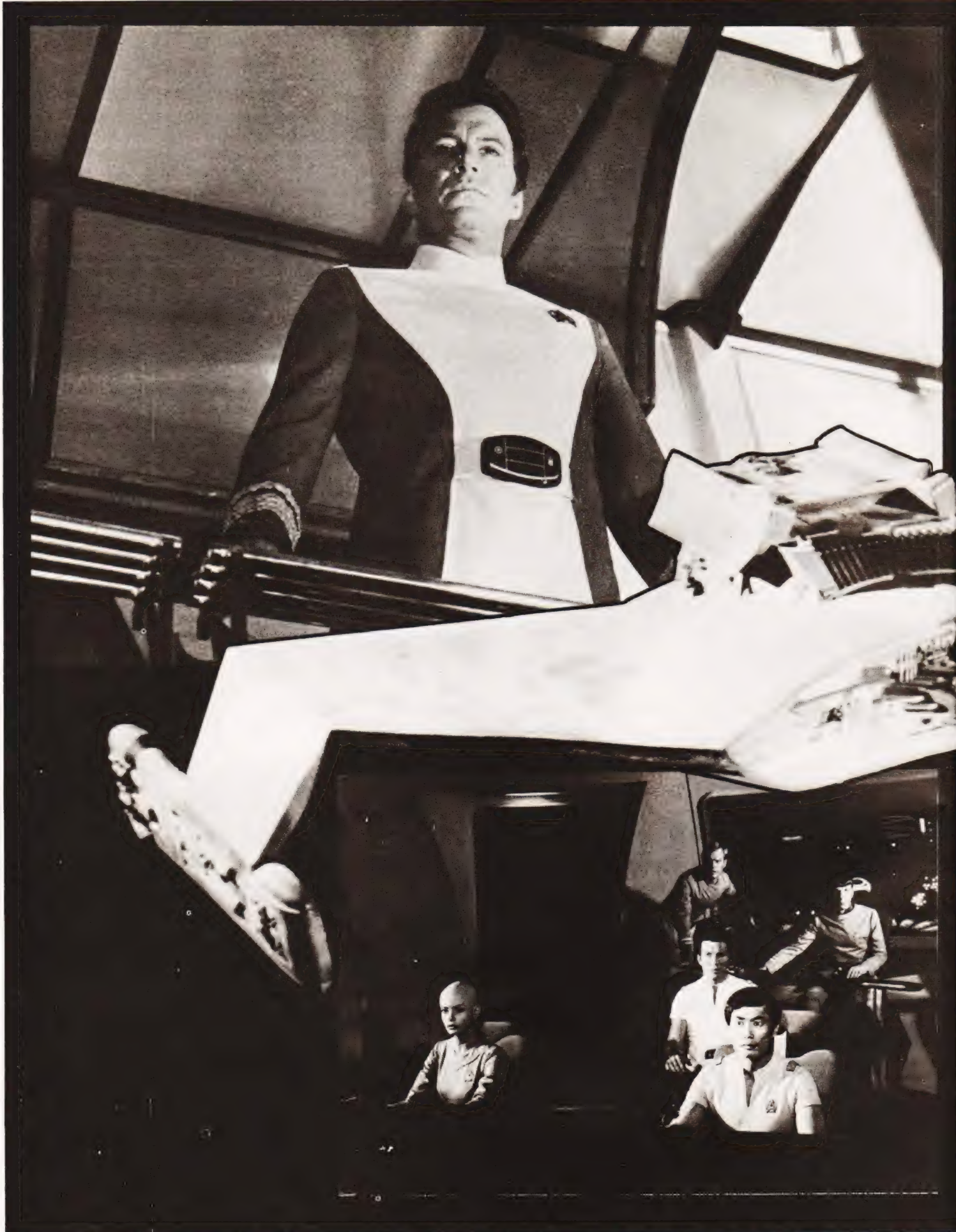
# ETI JULY 1980

WHAT TO LOOK FORWARD TO  
IN OUR JULY ISSUE! ON  
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Next month ETI presents the definitive history of the spacecraft. Ian Graham - our permanently high spaceman - talks us through the hardware of the fastest man-made vehicles to date and takes a look at those which take flight only in our imaginations. For everyone who has looked up at the stars and longed.

Also next issue we have the long awaited Image Co-ordinator which will allow you to do things with your stereo image that your mother wouldn't approve of! Moreover Tim Orr follows up his Handbook of this month, with an article in similar vein, this time on his favourite subject, Active Filters. Find out how to design them yourself in the July issue of ETI.

For the audio men there is our first look at one of the rising stars of hi-fi, the Quantum amplifier system. It can be bought as a kit, as modules, or as a fully built and working piece of equipment. As an example of their range we examine the 102 pre-amp and the 204 (110W per channel) power amp. Stand by your speakers.



# KIRK vs THE CURSOR

**Captain Kirk never had it so good! Liven up any graphics game with our simple techniques.**

**W**hile playing an old version of Startrek recently, I wondered what the real thing would be like. I could not help feeling that the real James T Kirk would have been zapped by a Klingon before the short-range scan was halfway up the screen.

## The Failings Of VDUs

The reason for most games behaving like a piece of electronic paper scrolling slowly with a vertical motion is largely historical. Most of the software used at present is adapted from the time when your interface with a computer was either a set of punched cards or a printer connected to a mainframe at the other end of a telephone line. Unfortunately, for many people, those 'good old days' are still with us. There were compensations, 32K BASIC interpreters and 64K

Startreks being just two of the advantages! What I wanted was to be able to print output to selected areas of the screen without disturbing material already present.

There appeared to be two basic methods.

1) I could POKE everything to my memory mapped screen, but this was going to be time consuming

to program when text had to be printed.

2) I could use the cursor movements provided by the manufacturer to signal the start positions of a print statement, but when a given output might appear anywhere on the screen this method too might prove difficult.

Are there other methods? After a little thought I decided that it must be possible to refine each of above methods as follows:—

1a) I could write a machine code subroutine to be called by the main program. This meant that I could get my assembler program to do the decoding of text for me.

2a) I could delve into page zero of memory, find where the machine stored the cursor position and see if I could use this to simplify the movement required.

## The Final Solution

In the end I decided to use all the above methods except for machine code. Each method was used where it seemed most appropriate and the final division was:—

Method 1 : used to simulate the final detonation. This always occurred in the same place and therefore it was easy to store the exact locations and characters in a data statement.

Method 2 : used for instructions and messages. There is little point in being clever just for the sake of it.

Method 2a : used to plot the alien spacecraft. Here we have a string of characters representing the craft which wander about the screen. Because they are always the same they fit nicely into a print statement but normal cursor control would have been messy.

What I wanted to be able to specify the starting position of the spacecraft string using the two coordinates XC and YC which save the displacements across and down from the top lefthand corner of the screen. I found that locations 196 and 197 of my PET hold the exact position of the cursor in Hex. The decimal value is always between 32K and 33K and may be found using the function  $256*PEEK(197)+PEEK(196)$ . In the program we require the inverse function and this is coded in lines 2860 to 2920 of the listing.

I won't claim that this is the greatest program I have ever written, but I did learn a great deal about cursor control while writing it. It is an enjoyable game by itself, but I feel that it will really come into its own as a subroutine to my Startrek program. After all, James T Kirk ought to have something extra now that they have made him a Commadore!



```

1000 REM *****
1020 REM *
1040 REM * PROGRAM ---- SPACE ATTACK
1060 REM *
1080 REM * PROGRAMMED IN 'PET' BASIC
1100 REM *
1120 REM * TREVOR L LUSTY 26/01/80
1140 REM *
1160 REM *****
1180 PRINT "[CLS] [8CD]"
1200 PRINT "[REV]"
1220 PRINT "[REV] SPACE ATTACK"
1240 PRINT "[REV]"
1260 FOR I=1 TO 1000:NEXT I
1280 POKE 59468,14
1300 PRINT "[CLS]SIX ALIEN INVADERS HAVE PENETRATED"
1320 PRINT "EARTH'S OUTER DEFENCES."
1340 PRINT:PRINT
1360 PRINT "AS COMMANDER OF THE LAST FIGHTER DEFENCE";
1380 PRINT "SHIP, YOUR MISSION IS TO DESTROY THEM."
1400 PRINT:PRINT
1420 PRINT "YOU MUST POSITION YOUR PHASER SIGHT"
1440 PRINT "SO THAT THE ALIEN CRAFT IS IN THE CENTRE";
1460 PRINT "AND THEN FIRE YOUR WEAPONS."
1480 PRINT:PRINT
1500 PRINT "PRESS 5 TO FIRE"
1520 PRINT "PRESS 8 TO MOVE YOUR SIGHT UP"
1540 PRINT "PRESS 2 TO MOVE YOUR SIGHT DOWN"
1560 PRINT "PRESS 4 TO MOVE YOUR SIGHT LEFT"
1580 PRINT "PRESS 6 TO MOVE YOUR SIGHT RIGHT"
1600 PRINT:PRINT
1620 PRINT "DAMAGE FROM ENEMY ATTACK WILL GRADUALLY"
1640 PRINT "DESTROY YOUR AIM ---- SO DON'T DELAY"
1660 PRINT
1680 PRINT "PRESS SPACE BAR WHEN READY"
1700 GET QS:IF QS <> "" THEN 1700
1720 POKE 59468,12
1740 PRINT "[CLS] RATINGS : B BEGINNER"
1760 PRINT "          N NOVICE"
1780 PRINT "          V VETERAN"
1800 INPUT "[5CD] RATING";RS
1820 IF RS="B" THEN RA=350:GOTO 1880
1840 IF RS="N" THEN RA=200:GOTO 1880
1860 IF RS="V" THEN RA=50
1880 PRINT "[CLS]"
1900 YC=10:XC=8:GOSUB 2860
1920 PRINT "TALLY HO AND GOOD LUCK"

```

```

1940 FOR N=1 TO 500:NEXT N
1960 MI=1:HI=1:PRINT "[CLS]"
1980 GOSUB 4100:REM *** FIND AND PRINT RATING ***
2000 GOSUB 2380:REM *** PRINT PHASER SIGHT ***
2020 YC=INT(8*RND(1)+10)
2040 XC=INT(20*RND(1)+5)
2060 GOSUB 2860:REM *** POSITION CURSOR ***
2080 GOSUB 2740:REM *** PRINT ALIEN CRAFT ***
2100 PRINT "[HOM]"
2120 GOSUB 3780:REM *** INCREMENT TIME AND TEST ***
2140 GET DS:IF DS="" THEN 2120
2160 GOSUB 2860:REM *** POSITION CURSOR ***
2180 IF DS="4" THEN XC=XC+1
2200 IF DS="6" THEN XC=XC-1
2220 IF DS="8" THEN YC=YC+1
2240 IF DS="2" THEN YC=YC-1
2260 IF DS="5" THEN 3000
2280 GOSUB 3600:REM *** REMOVE OLD POSITION ***
2300 GOSUB 2860:REM *** SET NEW POSITION ***
2320 GOSUB 2740:REM *** PRINT ALIEN CRAFT ***
2340 GOTO 2100
2360 FOR I=1 TO 2000:NEXT I:END
2380 PRINT "[HOM][4CD]:PRINT"
2400 PRINT "
2420 PRINT "
2440 PRINT "
2460 PRINT "[REV] ■
2480 PRINT "[REV] ■
2500 PRINT "[REV] ■
2520 PRINT "[REV] ■
2540 PRINT "[REV] ■
2560 PRINT "[REV] ■
2580 PRINT "
2600 PRINT "
2620 PRINT "
2640 PRINT "
2660 RETURN
2680 REM
2700 REM *** PRINT ALIEN CRAFT ***
2720 REM
2740 PRINT "◆-■-◆"
2760 P=YC:Q=XC
2780 RETURN
2800 REM
2820 REM *** SET CURSOR ***

```



# KIRK vs THE CURSOR



```
2840 REM
2860 S1=32768+40*YC+XC
2880 S3=INT(S1/256)
2900 S2=S1-256*S3
2920 POKE 196,S2 : POKE 197,S3 : RETURN
2940 REM
2960 REM *** TEST FOR HIT ***
2980 REM
3000 IF YC=12 THEN 3060
3020 GOSUB 3220
3040 GOTO 2060
3060 IF XC=17 THEN 3120
3080 GOSUB 3220
3100 GOTO 2060
3120 YC=12:XC=16:GOSUB 2860:GOSUB 4320:GOSUB 2380
3140 YC=21:XC=10:GOSUB 2860
3160 PRINT "ENEMY DESTROYED =";HI
3180 HI=HI+1:IF HI=7 THEN 3360
3200 GOTO 2020
3220 P=YC:Q=XC:YC=22:XC=10:GOSUB 2860
3240 PRINT "NUMBER MISSED =";MI:MI=MI+1
3260 YC=P:XC=Q:GOSUB 2860
3280 RETURN
3300 REM
3320 REM *** PRINT RESULTS ***
3340 REM
3360 YC=22:XC=10:GOSUB 2860
3380 MI=MI-1
3400 PRINT "[HOM]:YC=1:XC=0:GOSUB 2860
3420 PRINT "PLANET EARTH HAS BEEN SAVED"
3440 PRINT "[CLS] PERFORMANCE =";INT(6/(6+MI)*100);"%
3460 IF 6/(6+MI)*100 > 75 THEN RA=RA-75:IF RA < 15 THEN RA=25
3480 IF 6/(6+MI)*100 < 51 THEN RA=RA+50
3500 GOSUB 4100:YC=24:XC=0:GOSUB 2860
3520 PRINT "[REV] DO YOU WANT ANOTHER MISSION ?"
3540 GET QS:IF QS="" THEN 3540
3560 IF QS <> "Y" THEN END
3580 GOTO 1960
3600 S1=32768+40*P+Q
3620 S3=INT(S1/256)
3640 S2=S1-256*S3
3660 POKE 196,S2 : POKE 197,S3
3680 PRINT " "
3700 RETURN
3720 REM
```

```
3740 REM *** INCREMENT TIME ***
3760 REM
3780 T=T+1
3800 IF T > RA THEN 3900
3820 RETURN
3840 REM
3860 REM *** MOVE AND TEST ALIEN ***
3880 REM
3900 IF XC > 36 THEN 3980
3920 IF YC < 12 THEN 3980
3940 XC=XC-1:YC=YC+1:GOSUB 3600:GOSUB 2860:GOSUB 2740:PRINT
    "[HOM]"
3960 GOTO 4000
3980 XC=XC+1:YC=YC-1:GOSUB 3600:GOSUB 2860:GOSUB 2740:PRINT
    "[HOM]":GOTO 4000
4000 IF YC > 18 OR YC < 5 THEN PRINT "[CLS] [7CD] THEY GOTCHA":
    GOTO 2360
4020 T=0:RETURN
4040 REM
4060 REM *** SET RATINGS ***
4080 REM
4100 IF RA < =50 THEN QS="RATING = VETERAN PILOT" : GOTO 4160
4120 IF RA > =350 THEN QS="RATING = BEGINNER" : GOTO 4160
4140 QS="RATING = NOVICE PILOT"
4160 YC=2:XC=8:GOSUB 2860
4180 PRINT " "
4200 YC=2:XC=8:GOSUB 2860
4220 PRINT QS
4240 RETURN
4260 REM
4280 REM *** SIMULATE HIT ***
4300 REM
4320 RESTORE
4340 FOR J=1 TO 15
4360 READ L,M
4380 POKE L,M
4400 NEXT J
4420 RETURN
4440 DATA 33267,42,33266,42,33268,42
4460 DATA 33227,42,33307,42,33267,32
4480 DATA 33265,42,33269,42,33266,32
4500 DATA 33268,32,33227,32,33307,32
4520 DATA 33269,32,33265,32,33267,91
READY.
```

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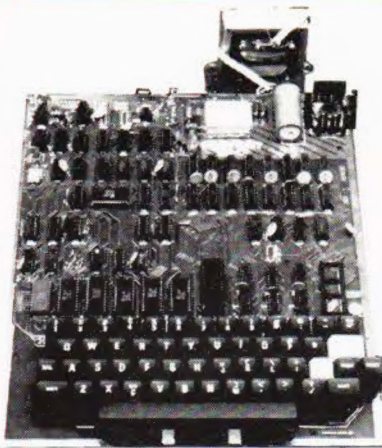
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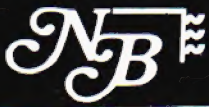
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